Update on Shasta River TMDL Development Status

May 13, 2004

Purpose of Meeting

- **To update the TAG on the status of Shasta River TMDL development activities.**
- **To summarize 2002 & 2003 water quality monitoring activities and results.**
- **To discuss data analysis approach.**
- **To discuss 2004 water quality monitoring plans.**
- **To answer questions and receive feedback.**

2002 & 2003 Monitoring Activities

- Thermal infrared survey
- Continuous monitoring of temperature, DO, pH, conductance (sondes):
  - 2002: 3 sites
  - 2003: 4 permanent sites; 13 periodic sites
- Continuous temperature monitoring:
  - 2003: 9 sites
- Field measurement of temperature, DO, pH, conductance:
  - 2003: all sonde and most grab sites

2002 & 2003 Monitoring Activities cont.

- Grab sample analysis of nutrients, oxygen demanding constituents, and Chl a:
  - 2002 Baseline monitoring: 3 Shasta River sites
  - Parcel tracking studies: 8 Shasta River sites
  - Background nutrients – 4 upper tributary sites and 6 springs
  - Wastewater treatment plant bracketing
  - Irrigation return flows (16 samples)
  - Lake Shastina profile study
- Sediment Oxygen Demand Study
- Flow measurements

Figure 1. Shasta River Watershed

(Sampling Locations - NCRWQCB 2003)

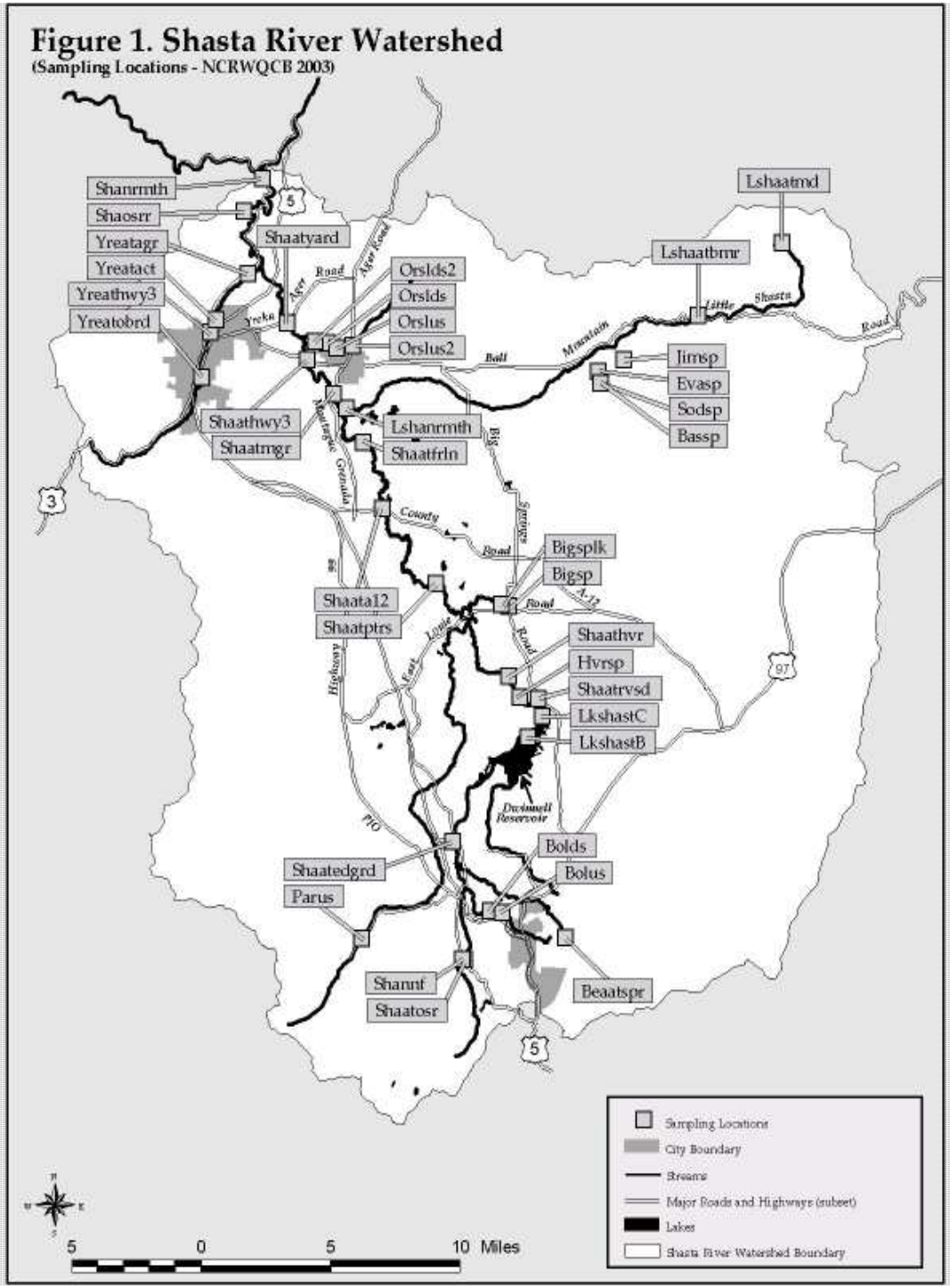


Table 1. Shasta River Water Quality Monitoring Locations and Activities

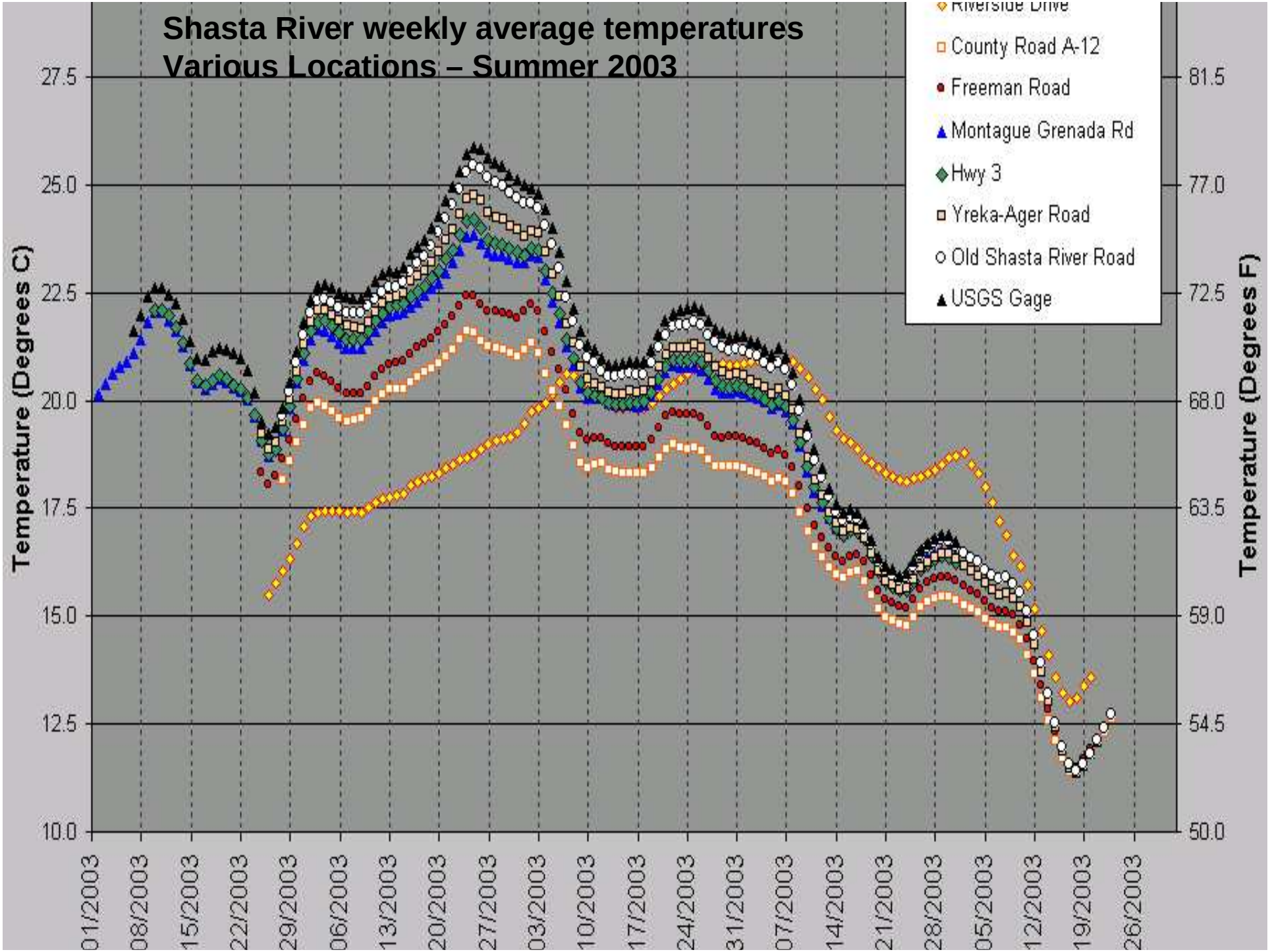
Site ID	Site Location	River Mile[1]	Grab Sampling	Sonde Location[2]	Temperature Location[3]	SOD Location[4]
Shanrmth	Shasta River near Mouth at USGS Gage	0.6	X	X		
Shaosrr	Shasta River at Old Shasta River Road	4.0			X	
Shaatyard	Shasta River at Yreka-Ager Road	10.4	X	X	X	
Shaathwy3	Shasta River at Highway 3	12.3	X	X		X
Shaatmgr	Shasta River at Montague-Grenada Road	14.7	X	X		X
Shaatfrln	Shasta River at Freeman Road	17.9	X	X	X	
Shaata12	Shasta River at Highway A12	21.9	X	X	X	
Shaatptrs	Shasta River 1.9 Miles Downstream of Big Springs Creek	27.9	X	X		
Shaathwr	Shasta River at Big Springs Road	33.7	X			
Shaatrvsd	Shasta River at Riverside Drive	35.7	X	X	X	
Lake Shastina (Dwinnell Reservoir) is located at river mile 36.4.						
All locations upstream of Shastina are determined using an assumed stream length along the floor of Shastina.						
LkshastB	Lake Shastina -- Station B		X	X		
LkshastC	Lake Shastina -- Station C		X	X		
Shaatedgrd	Shasta River at Edgewood Road	42.9	X	X		
Shaatosr	Shasta River at Old Stage Road	47.7	X			
Shannf	North N Fork Shasta River	47.5+0.1	X			
Lshanrmth	Little Shasta River Near Mouth	15.5+0.3	X	X	X	
Lshaatbmr	Little Shasta River at Ball Mountain Road	15.5+10.0	X			
Lshatmd	Little Shasta River at Martin's Dairy Campground	15.5+23.8	X			
Yreatagr	Yreka Creek at Anderson Grade Road	7.6+0.6	X			
Yreatact	Yreka Creek at Cutoff Trench	7.6+2.9	X			
Yreathwy3	Yreka Creek at Highway 3	7.6+3.4	X			
Yreatobrd	Yreka Creek at Oberlin Road	7.6+5.3	X			
Orslus	Oregon Slough Upstream of Montague Wastewater Treatment Ponds	11.2+1.6	X			
Orslds	Oregon Slough Downstream of Montague Wastewater Treatment Ponds	11.2+1.1	X			
Parus	Parks Creek Upper	30.4+17.0	X		X	
Beaatspr	Beaughton Creek Upper	43.7+5.8	X			
Bolds	Boles Creek Downstream of City of Weed Wastewater Treatment Ponds	44.8+1.8	X		X	
Bolus	Boles Creek Upstream of City of Weed Wastewater Treatment Ponds	44.8+2.3	X			
Bassp	Bassey Spring		X	X		
Sodsp	Soda Spring		X			
Evasp	Evans Spring		X			
Jimsp	Jim Spring		X			
Hvrsp	Hidden Valley Spring		X	X		
Bigsplk	Big Springs Lake		X	X		
Bigsp	Big Springs Spring		X	X		

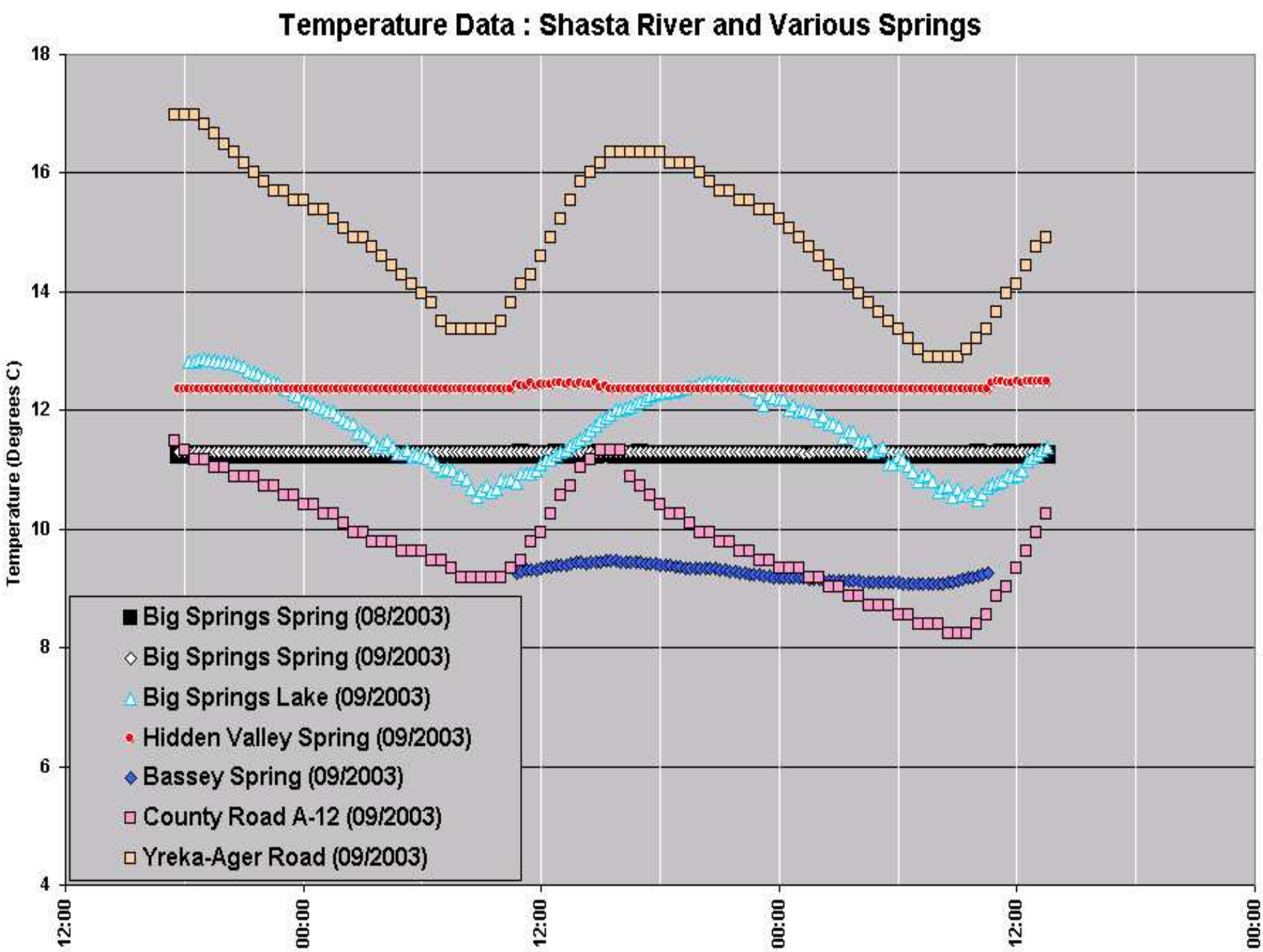
[1] River Miles for tributary locations are identified as the Shasta River miles at the confluence + the miles upstream of the confluence

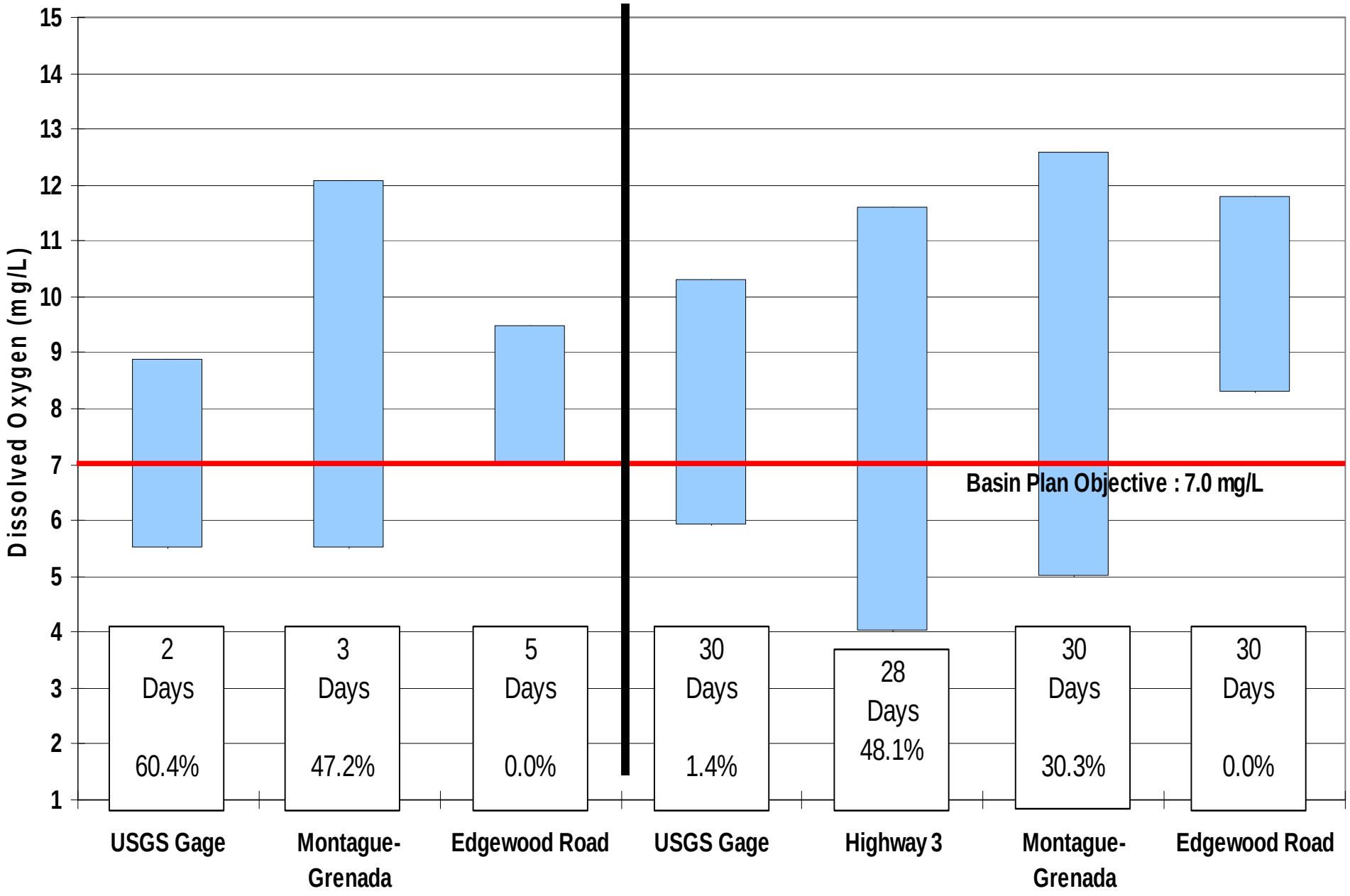
[2] Sonde Location = Continuous measurement of temperature, dissolved oxygen, pH, and specific conductance with sonde.

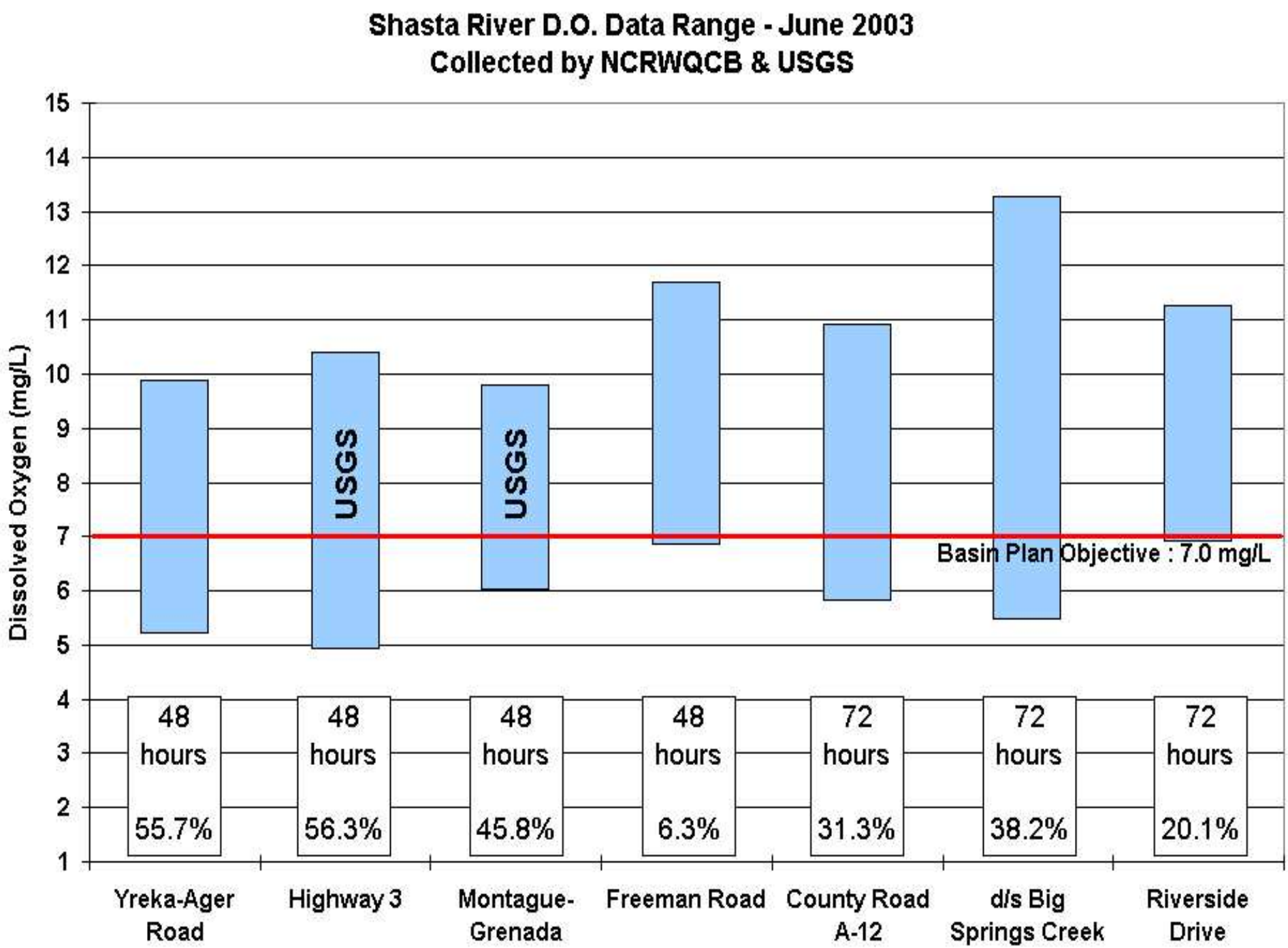
[3] Temperature Location = Continuous measurement of temperature with Optic StowAway.

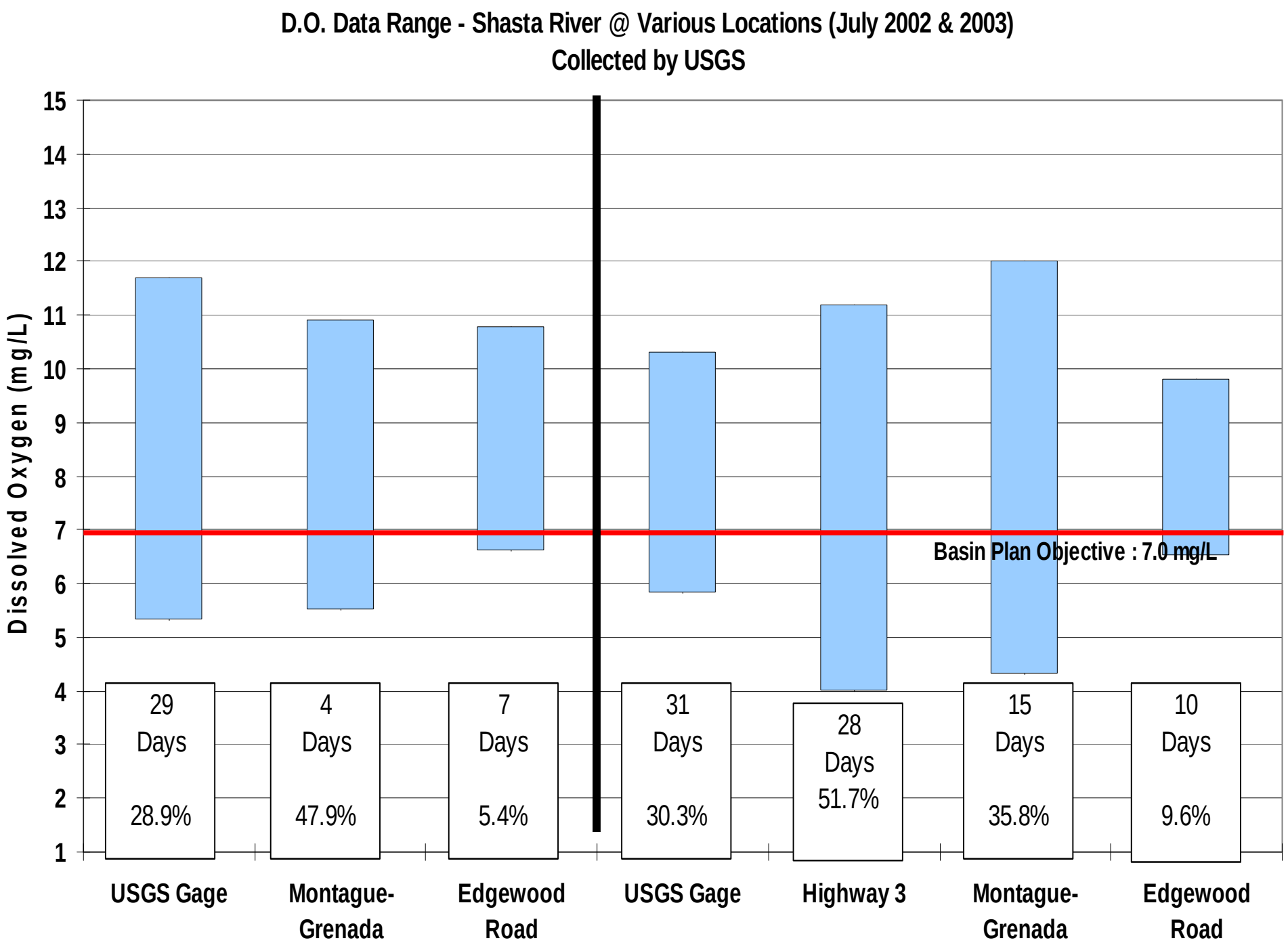
[4] SOD Location = Sediment oxygen demand measurement location.

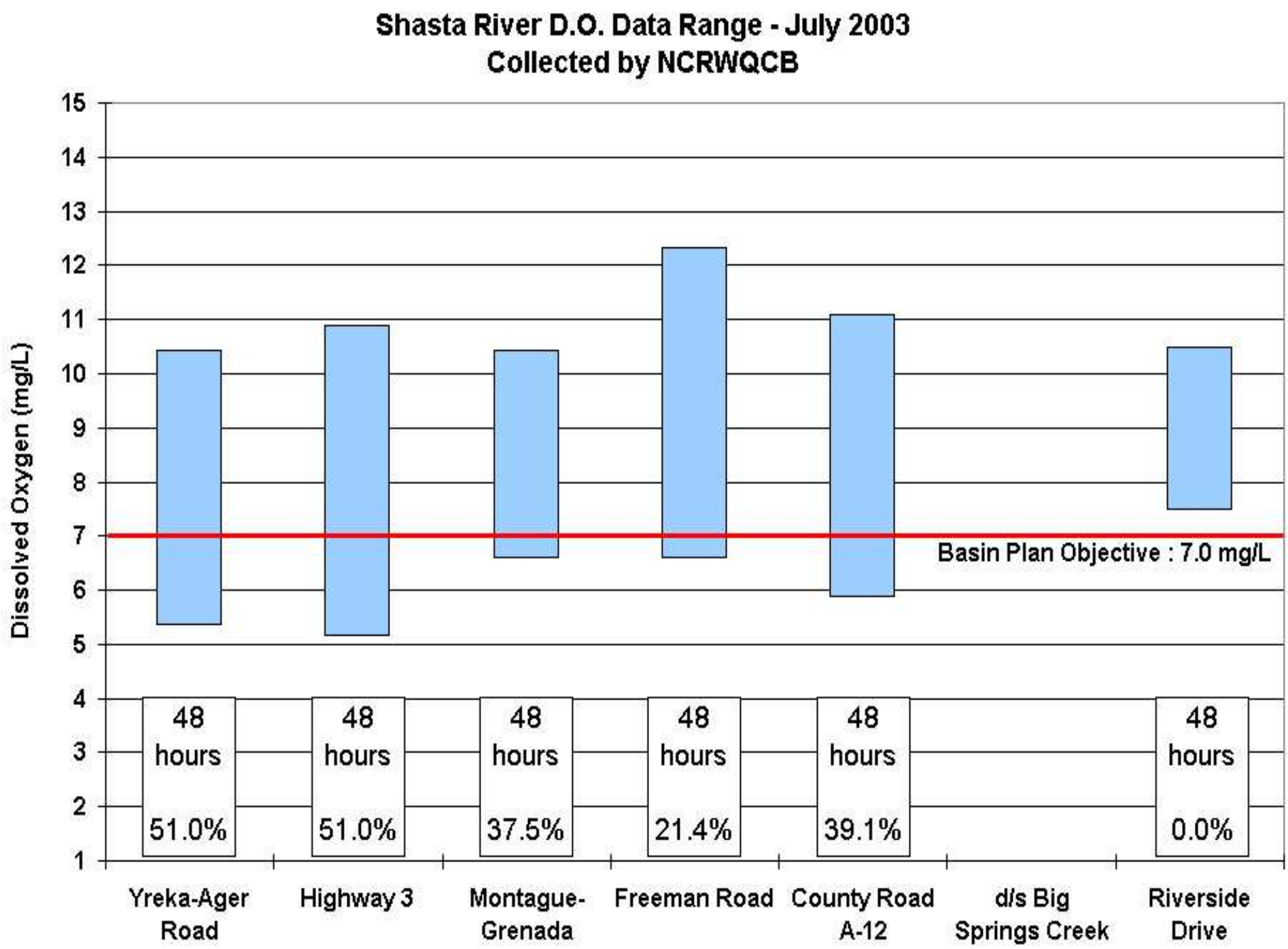

Shasta River weekly average temperatures
Various Locations – Summer 2003
Riverside Drive
County Road A-12
Freeman Road
Montague Grenada Rd
Hwy 3
Yreka-Ager Road
Old Shasta River Road
USGS Gage
Temperature (Degrees C)
Temperature (Degrees F)
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
81.5
77.0
72.5
68.0
63.5
59.0
54.5
50.0
01/2003
08/2003
15/2003
22/2003
29/2003
06/2003
13/2003
20/2003
27/2003
03/2003
10/2003
17/2003
24/2003
31/2003
07/2003
14/2003
21/2003
28/2003
05/2003
12/2003
19/2003
26/2003

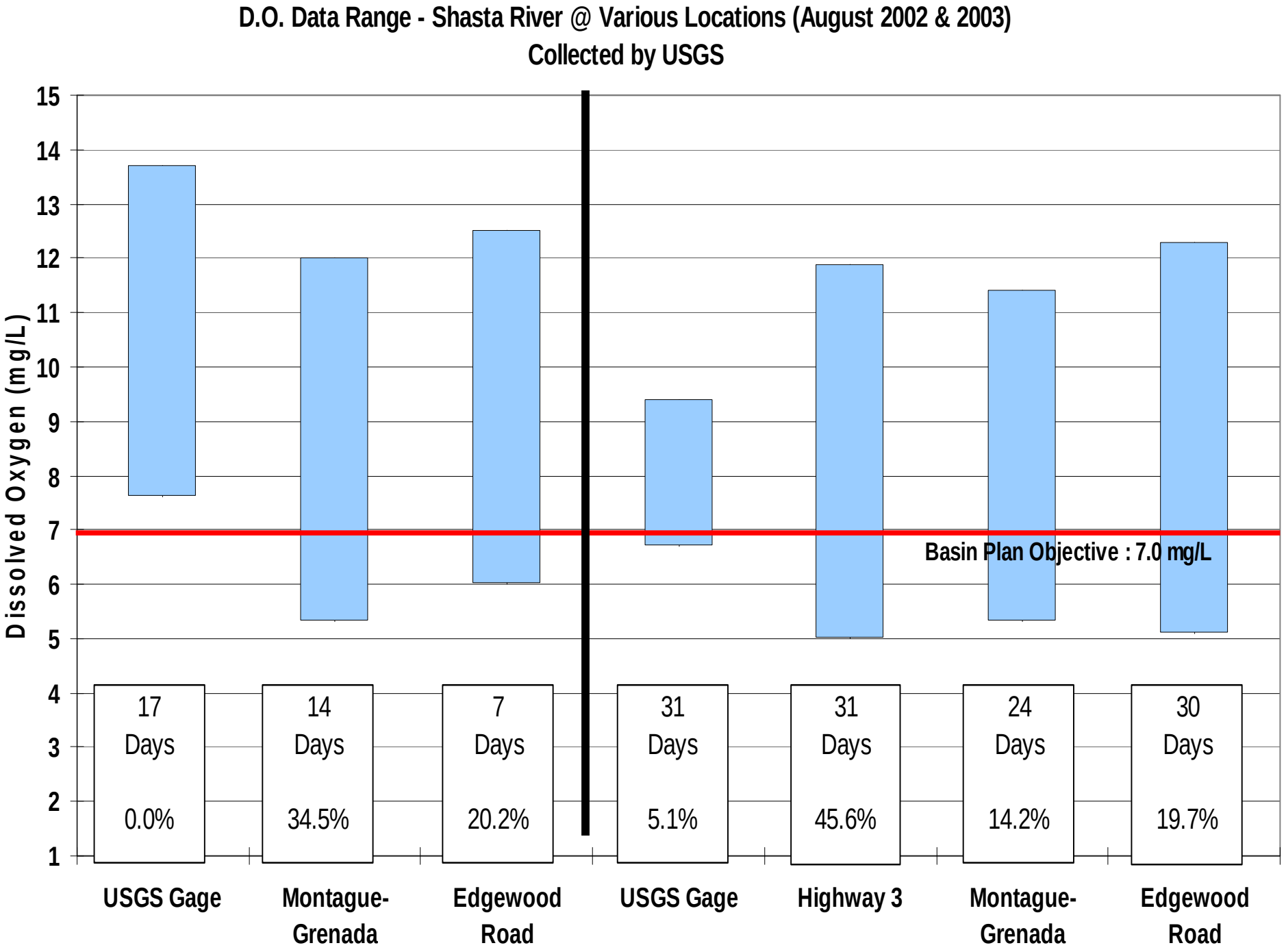

Temperature Data : Shasta River and Various Springs
Temperature (Degrees C)
18
16
14
12
10
8
6
4
12:00
00:00
12:00
00:00
12:00
00:00
Big Springs Spring (08/2003)
Big Springs Spring (09/2003)
Big Springs Lake (09/2003)
Hidden Valley Spring (09/2003)
Bassey Spring (09/2003)
County Road A-12 (09/2003)
Yreka-Ager Road (09/2003)

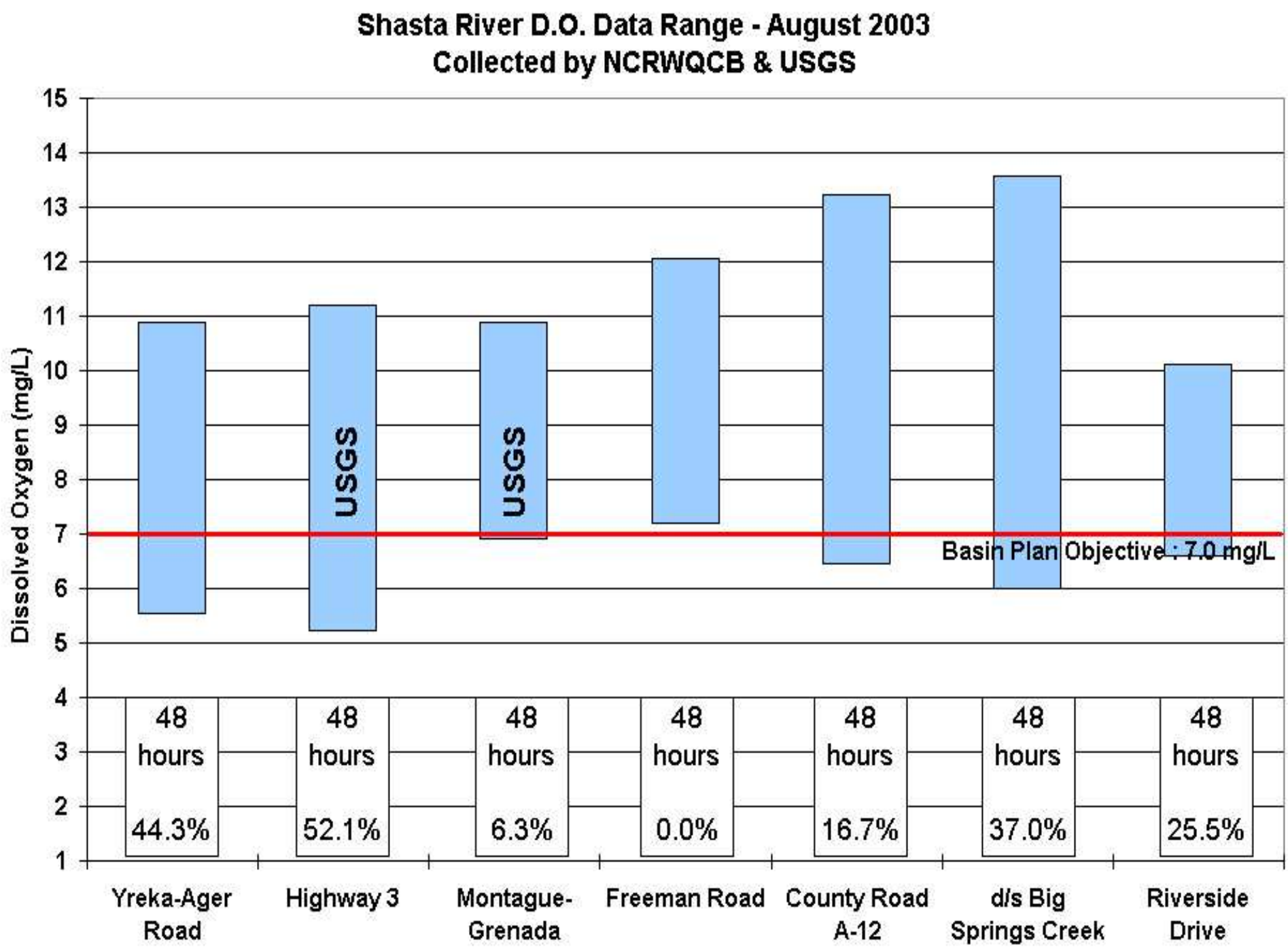

D.O. Data Range - Shasta River @ Various Locations (June 2002 & 2003)
Collected by USGS
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
2 Days 60.4%
3 Days 47.2%
5 Days 0.0%
30 Days 1.4%
28 Days 48.1%
30 Days 30.3%
30 Days 0.0%
USGS Gage
Montague-Grenada
Edgewood Road
USGS Gage
Highway 3
Montague-Grenada
Edgewood Road

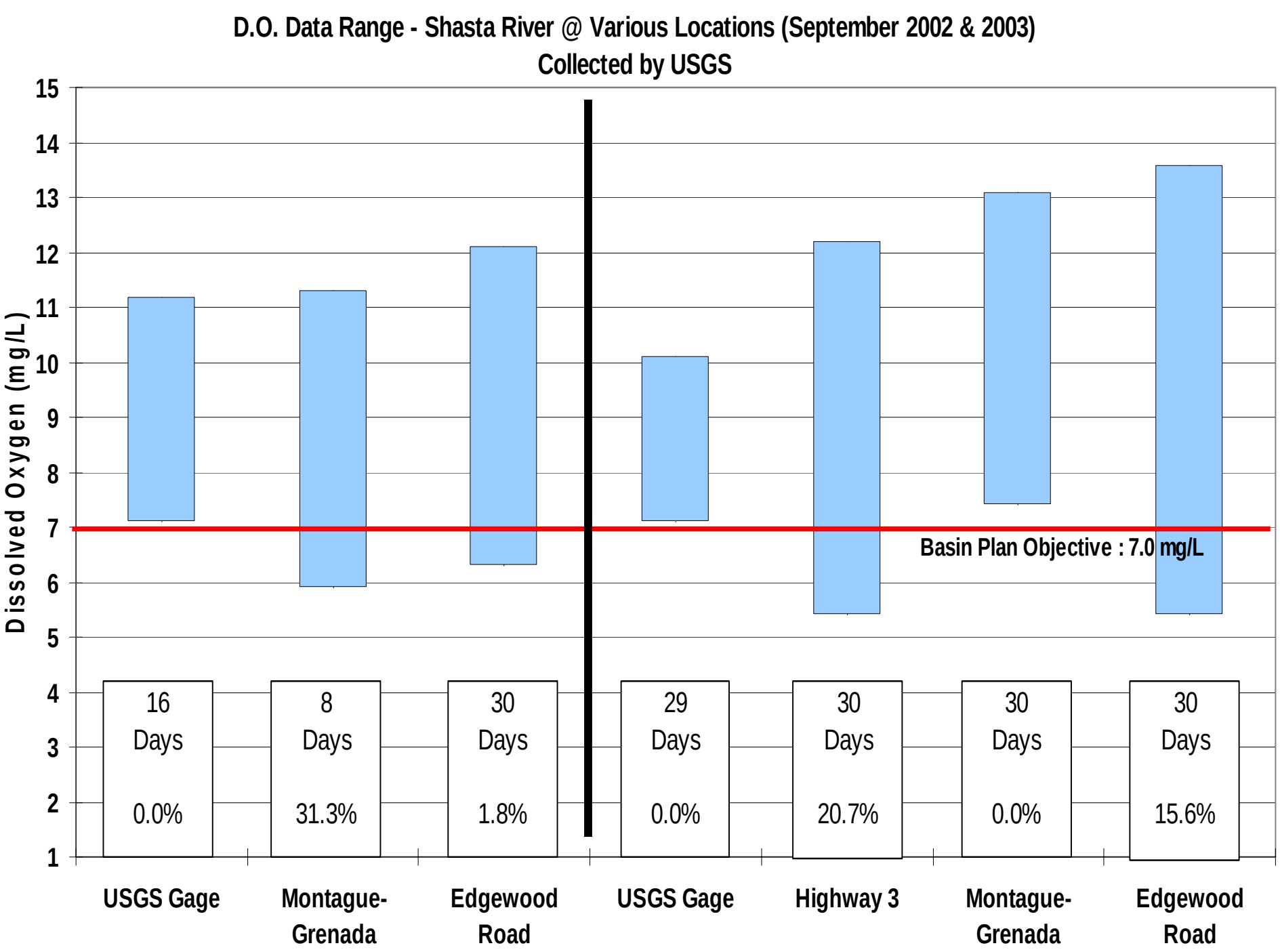

Shasta River D.O. Data Range - June 2003
Collected by NCRWQCB & USGS
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
USGS
USGS
Basin Plan Objective : 7.0 mg/L
48 hours 55.7%
48 hours 56.3%
48 hours 45.8%
48 hours 6.3%
72 hours 31.3%
72 hours 38.2%
72 hours 20.1%
Yreka-Ager Road
Highway 3
Montague-Grenada
Freeman Road
County Road A-12
d/s Big Springs Creek
Riverside Drive

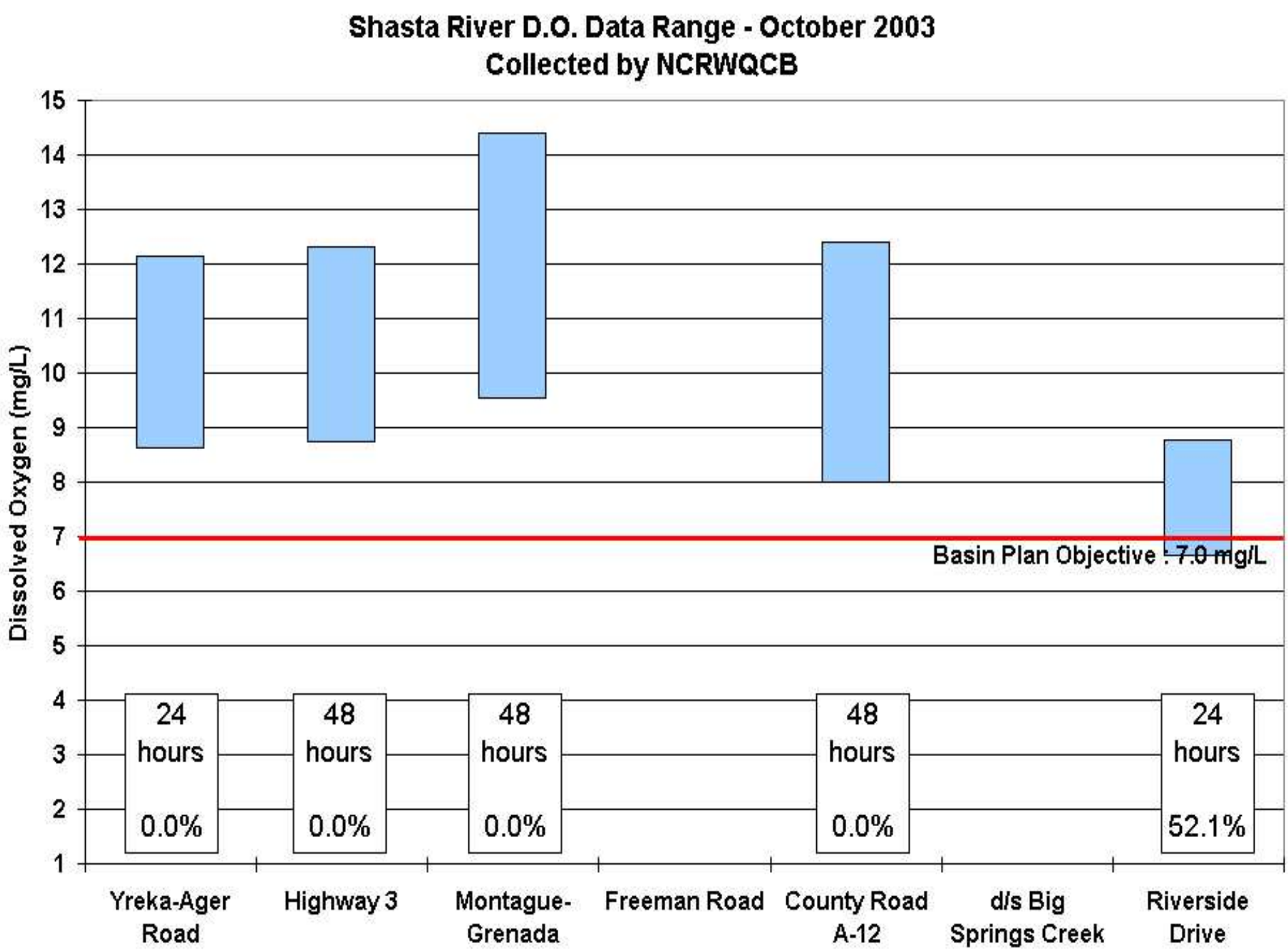

D.O. Data Range - Shasta River @ Various Locations (July 2002 & 2003)
Collected by USGS
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
29 Days 28.9%
4 Days 47.9%
7 Days 5.4%
31 Days 30.3%
28 Days 51.7%
15 Days 35.8%
10 Days 9.6%
USGS Gage
Montague-Grenada
Edgewood Road
USGS Gage
Highway 3
Montague-Grenada
Edgewood Road

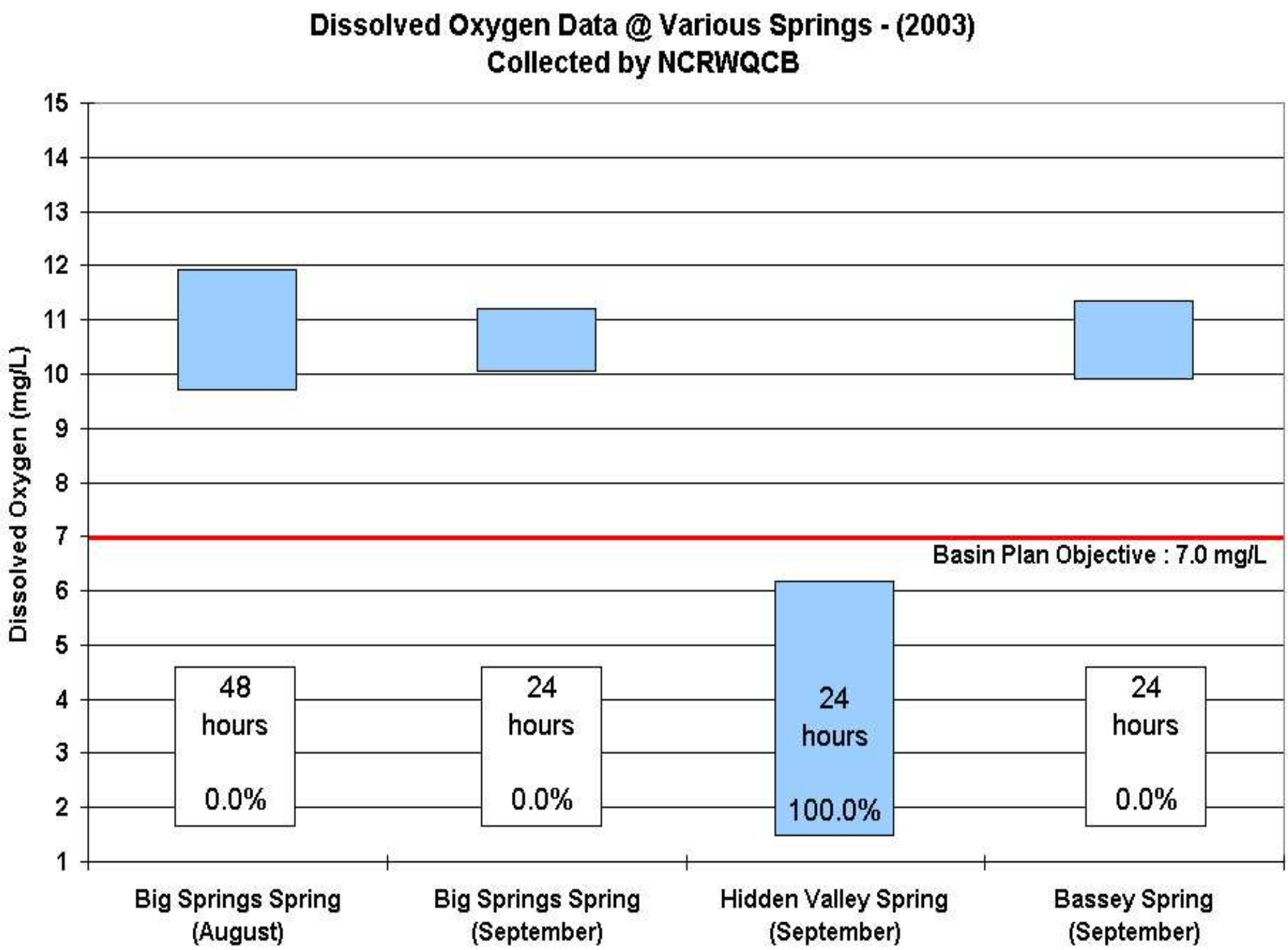

Shasta River D.O. Data Range - July 2003
Collected by NCRWQCB
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
48 hours 51.0%
48 hours 51.0%
48 hours 37.5%
48 hours 21.4%
48 hours 39.1%
48 hours 0.0%
Yreka-Ager Road
Highway 3
Montague-Grenada
Freeman Road
County Road A-12
d/s Big Springs Creek
Riverside Drive

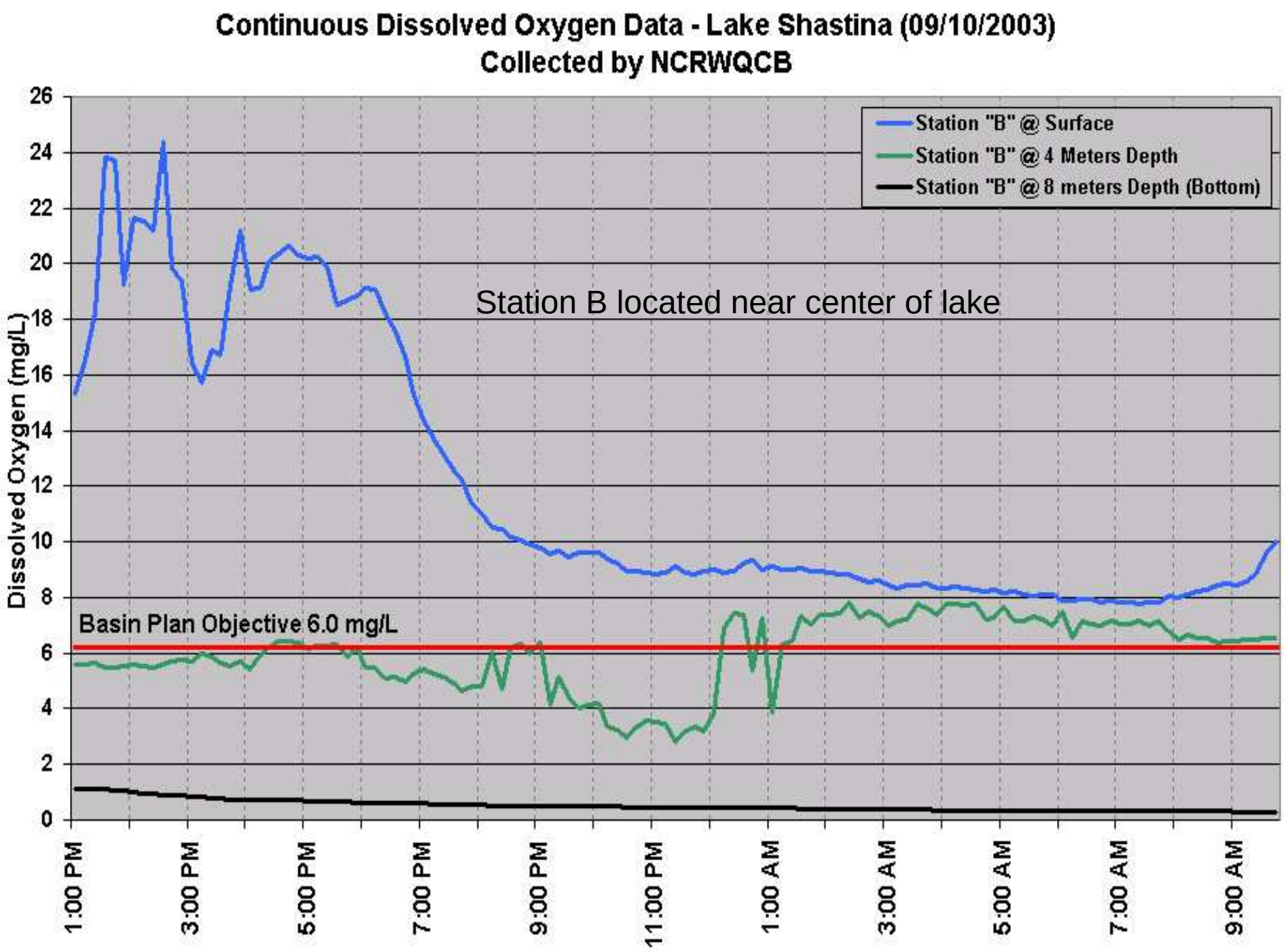

D.O. Data Range - Shasta River @ Various Locations (August 2002 & 2003)
Collected by USGS
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
17 Days 0.0%
14 Days 34.5%
7 Days 20.2%
31 Days 5.1%
31 Days 45.6%
24 Days 14.2%
30 Days 19.7%
USGS Gage
Montague-Grenada
Edgewood Road
USGS Gage
Highway 3
Montague-Grenada
Edgewood Road

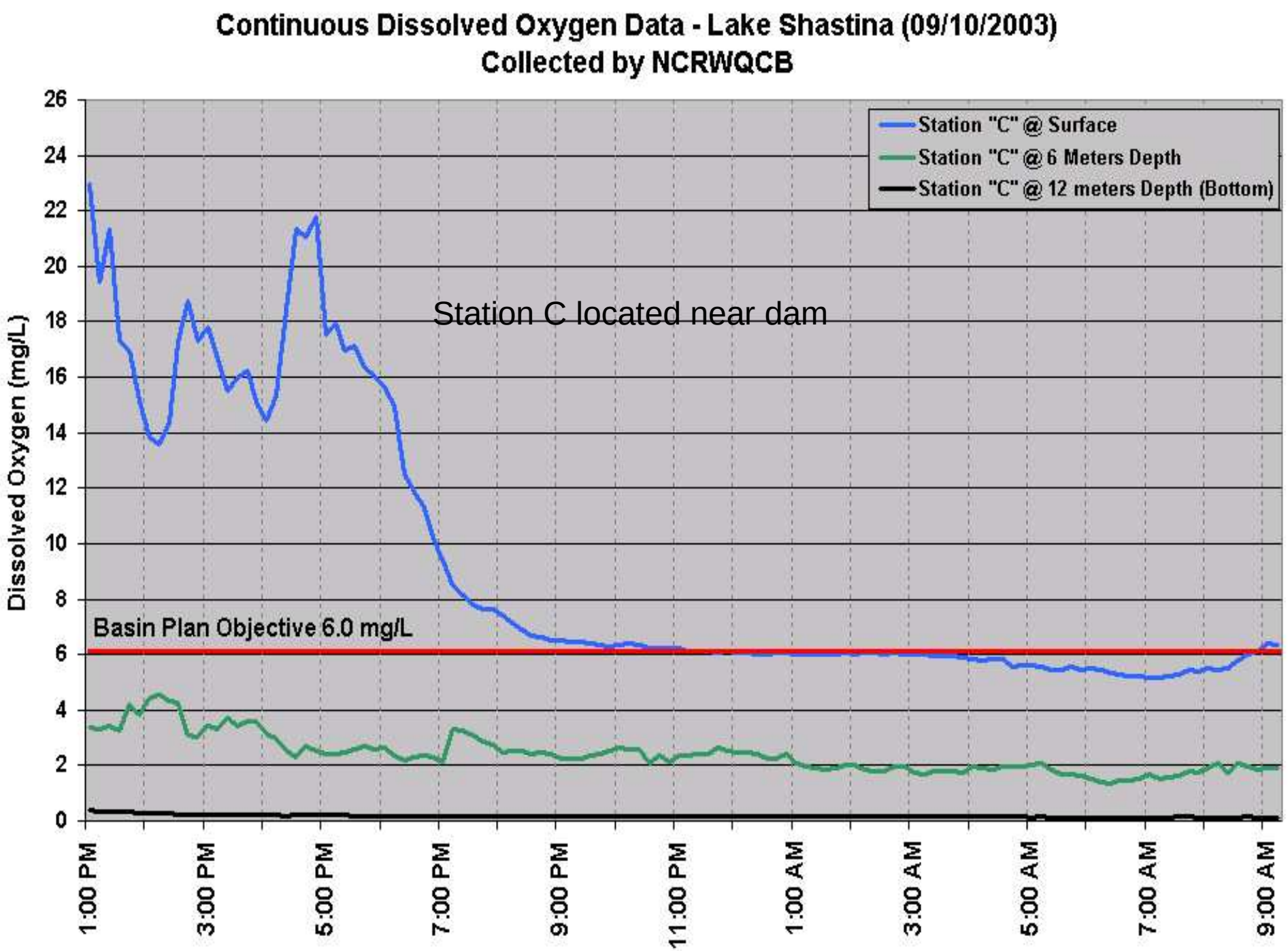

Shasta River D.O. Data Range - August 2003
Collected by NCRWQCB & USGS
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
USGS
USGS
Basin Plan Objective : 7.0 mg/L
48 hours 44.3%
48 hours 52.1%
48 hours 6.3%
48 hours 0.0%
48 hours 16.7%
48 hours 37.0%
48 hours 25.5%
Yreka-Ager Road
Highway 3
Montague-Grenada
Freeman Road
County Road A-12
d/s Big Springs Creek
Riverside Drive

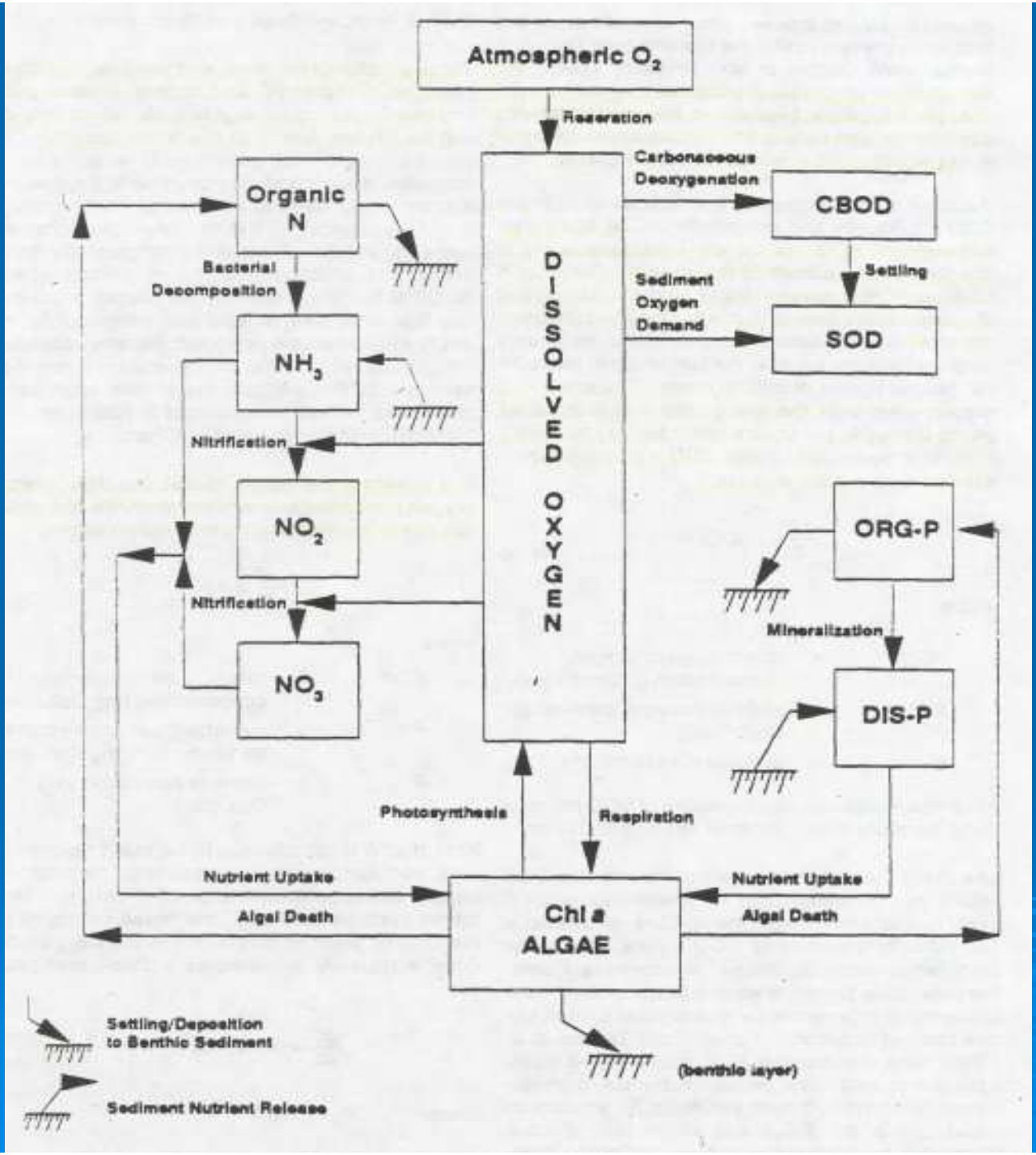

D.O. Data Range - Shasta River @ Various Locations (September 2002 & 2003)
Collected by USGS
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
16 Days 0.0%
8 Days 31.3%
30 Days 1.8%
29 Days 0.0%
30 Days 20.7%
30 Days 0.0%
30 Days 15.6%
USGS Gage
Montague-Grenada
Edgewood Road
USGS Gage
Highway 3
Montague-Grenada
Edgewood Road

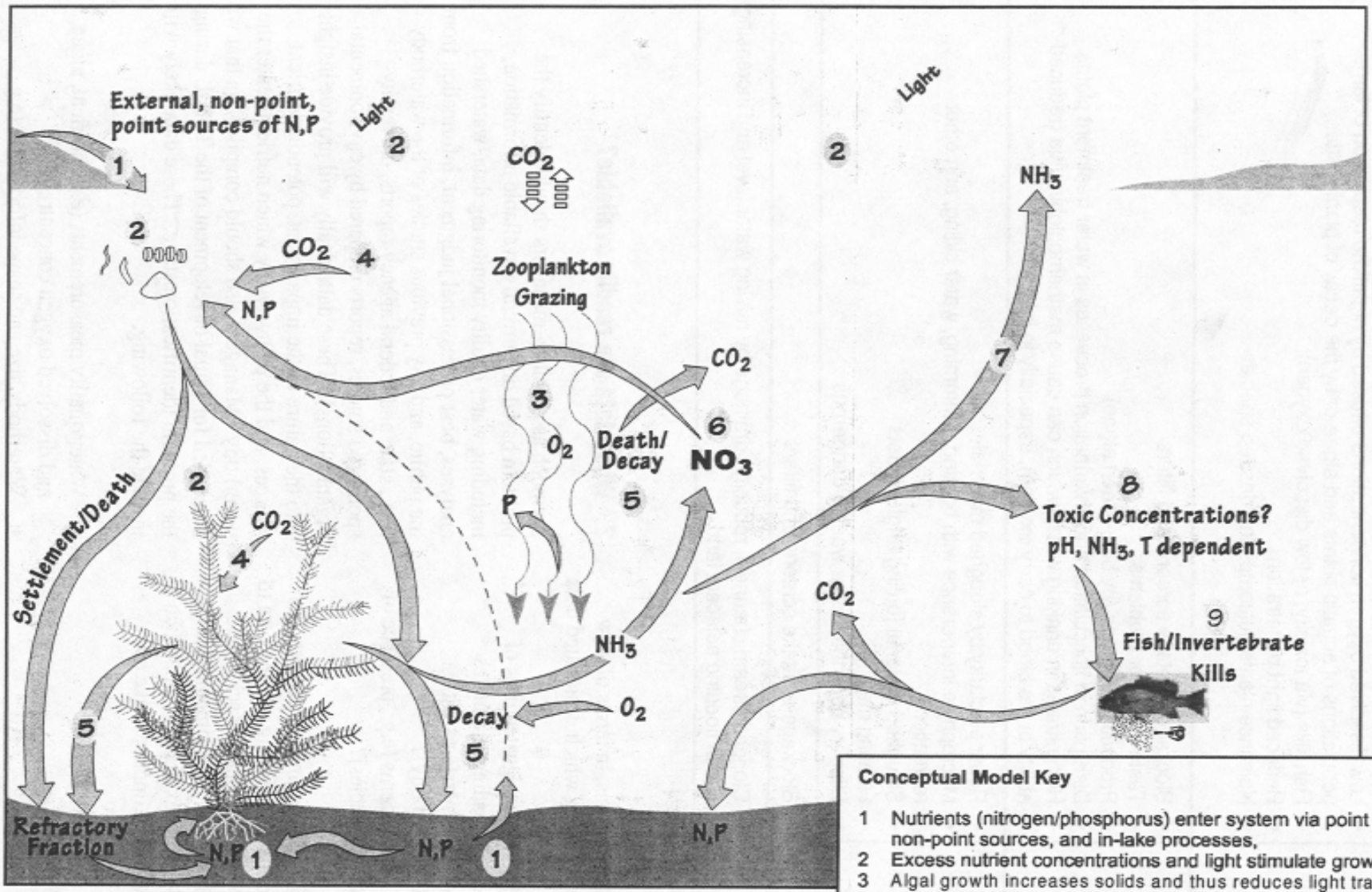

Shasta River D.O. Data Range - October 2003
Collected by NCRWQCB
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
24 hours 0.0%
48 hours 0.0%
48 hours 0.0%
48 hours 0.0%
24 hours 52.1%
Yreka-Ager Road
Highway 3
Montague-Grenada
Freeman Road
County Road A-12
d/s Big Springs Creek
Riverside Drive


Dissolved Oxygen Data @ Various Springs - (2003)
Collected by NCRWQCB
Dissolved Oxygen (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
Basin Plan Objective : 7.0 mg/L
48 hours 0.0%
24 hours 0.0%
24 hours 100.0%
24 hours 0.0%
Big Springs Spring (August)
Big Springs Spring (September)
Hidden Valley Spring (September)
Bassey Spring (September)


Continuous Dissolved Oxygen Data - Lake Shastina (09/10/2003)
Collected by NCRWQCB
Station "B" @ Surface
Station "B" @ 4 Meters Depth
Station "B" @ 8 meters Depth (Bottom)
Station B located near center of lake
Basin Plan Objective 6.0 mg/L
Dissolved Oxygen (mg/L)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1:00 PM
3:00 PM
5:00 PM
7:00 PM
9:00 PM
11:00 PM
1:00 AM
3:00 AM
5:00 AM
7:00 AM
9:00 AM

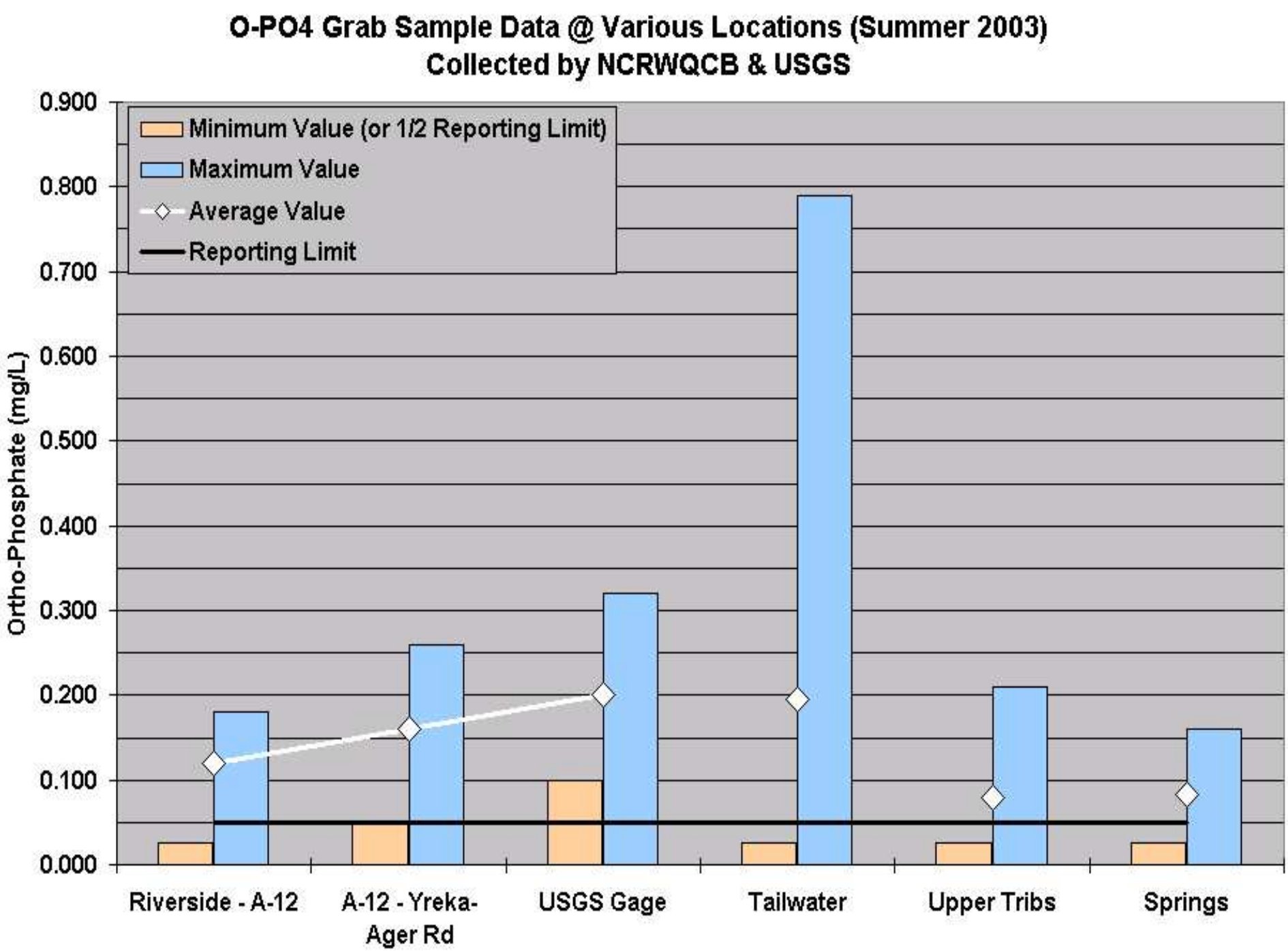

Continuous Dissolved Oxygen Data - Lake Shastina (09/10/2003)
Collected by NCRWQCB
Station "C" @ Surface
Station "C" @ 6 Meters Depth
Station "C" @ 12 meters Depth (Bottom)
Station C located near dam
Basin Plan Objective 6.0 mg/L
Dissolved Oxygen (mg/L)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1:00 PM
3:00 PM
5:00 PM
7:00 PM
9:00 PM
11:00 PM
1:00 AM
3:00 AM
5:00 AM
7:00 AM
9:00 AM

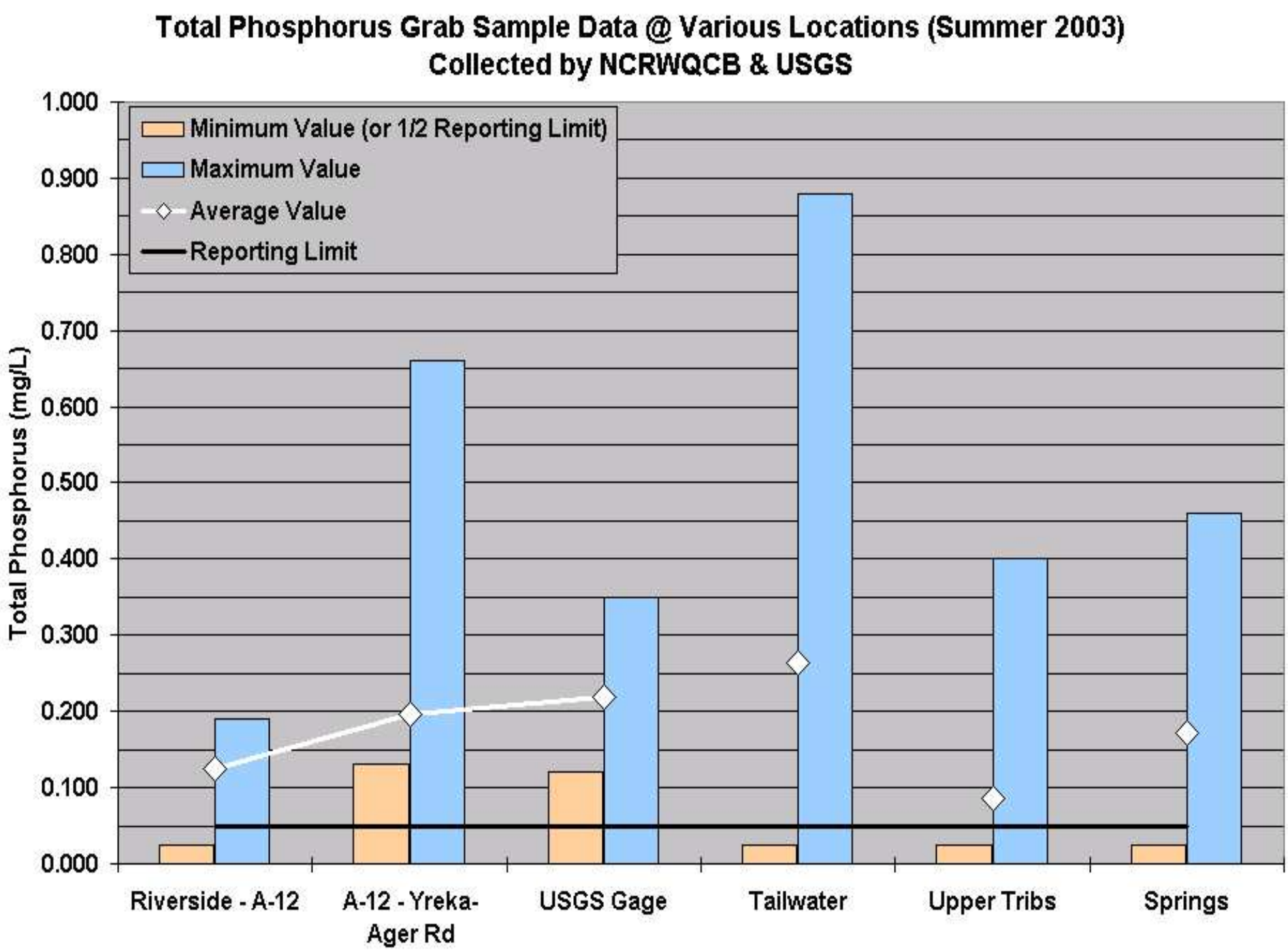

Atmospheric O_2
Reaeration
Carbonaceous Deoxygenation
CBOD
Settling
Sediment Oxygen Demand
SOD
Organic N
Bacterial Decomposition
NH_3
Nitrification
NO_2
Nitrification
NO_3
DISSOLVED OXYGEN
ORG-P
Mineralization
DIS-P
Photosynthesis
Respiration
Nutrient Uptake
Algal Death
Chl a ALGAE
Nutrient Uptake
Algal Death
Settling/Deposition to Benthic Sediment
Sediment Nutrient Release
(benthic layer)

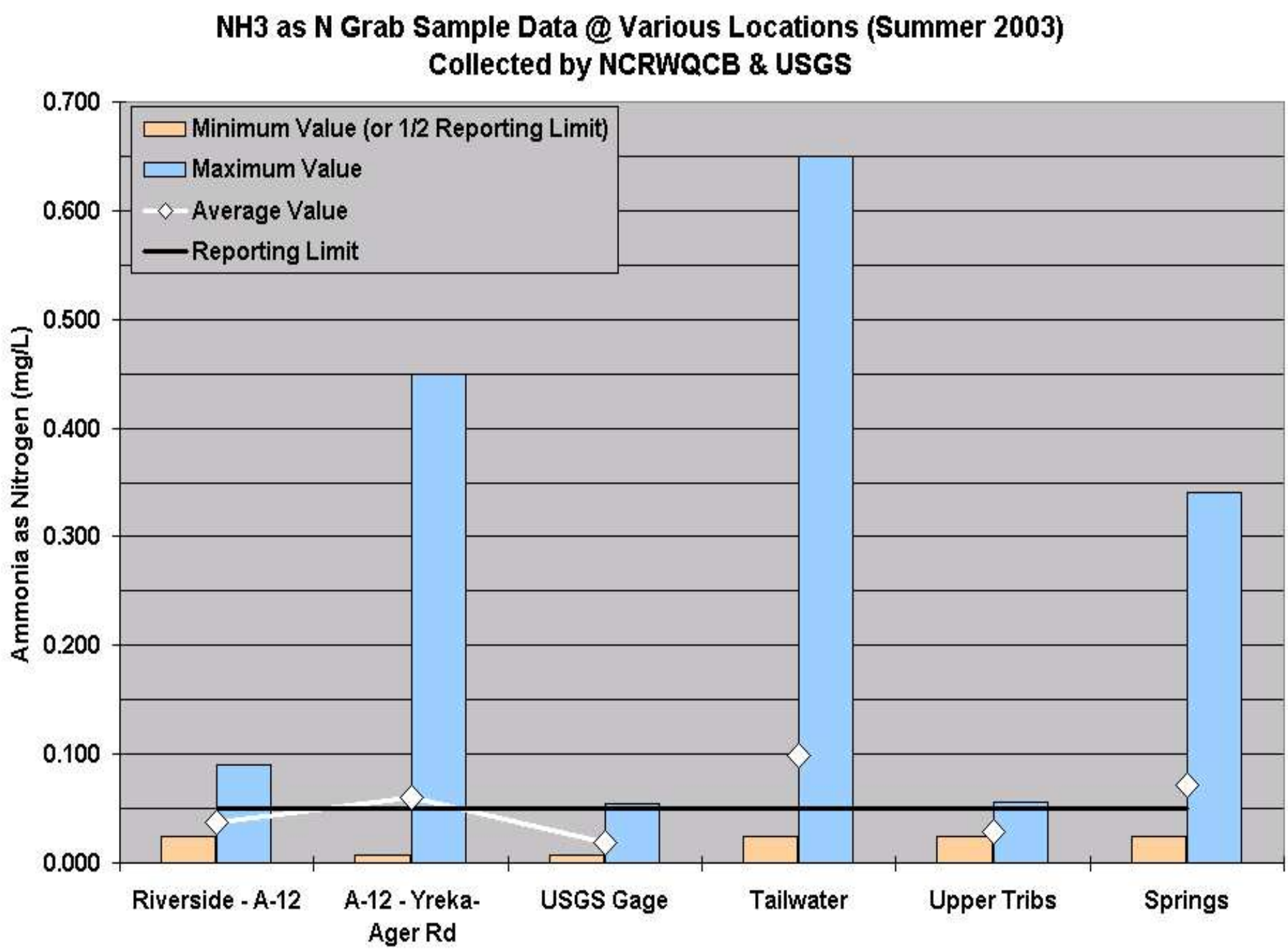


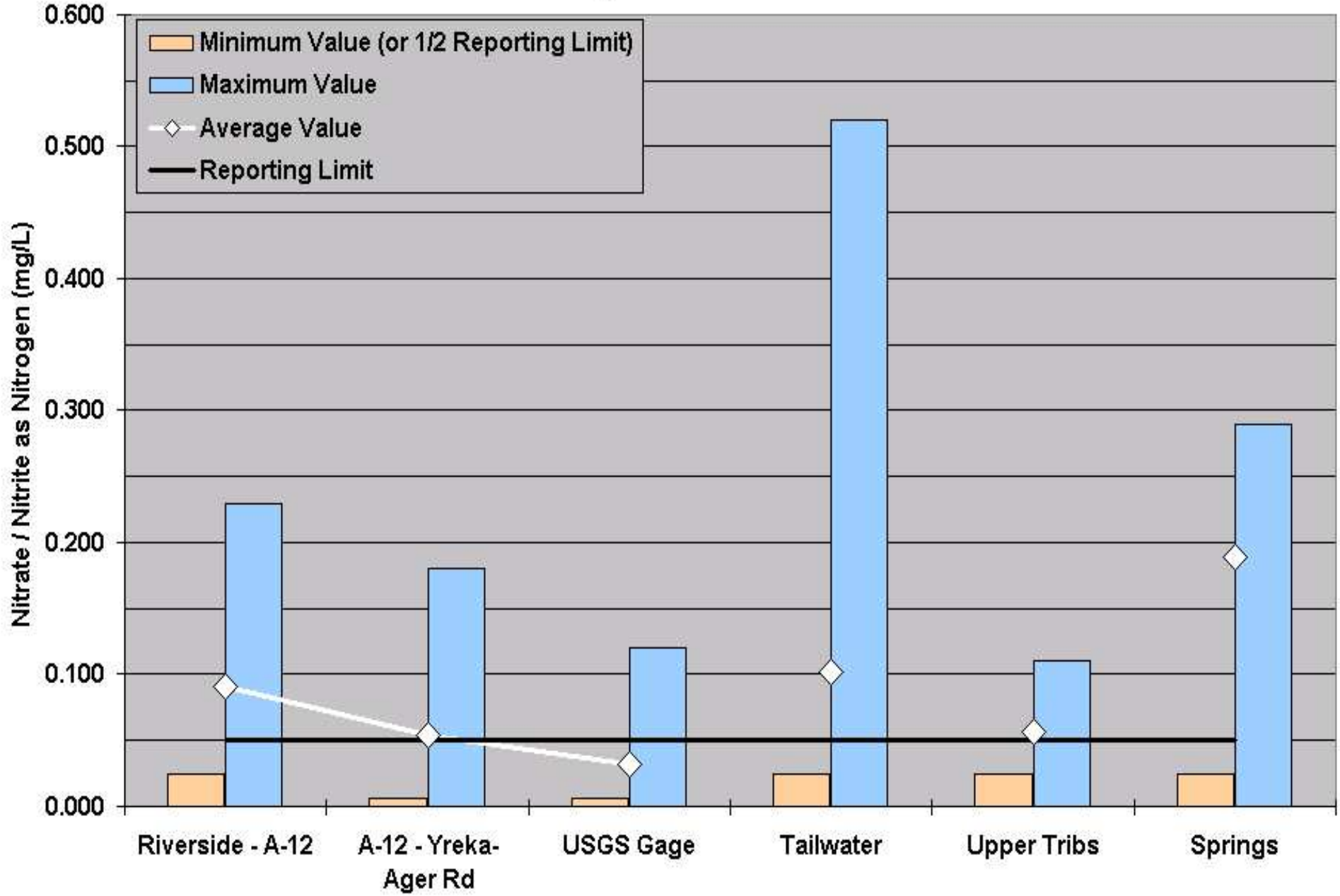
Conceptual Model Key

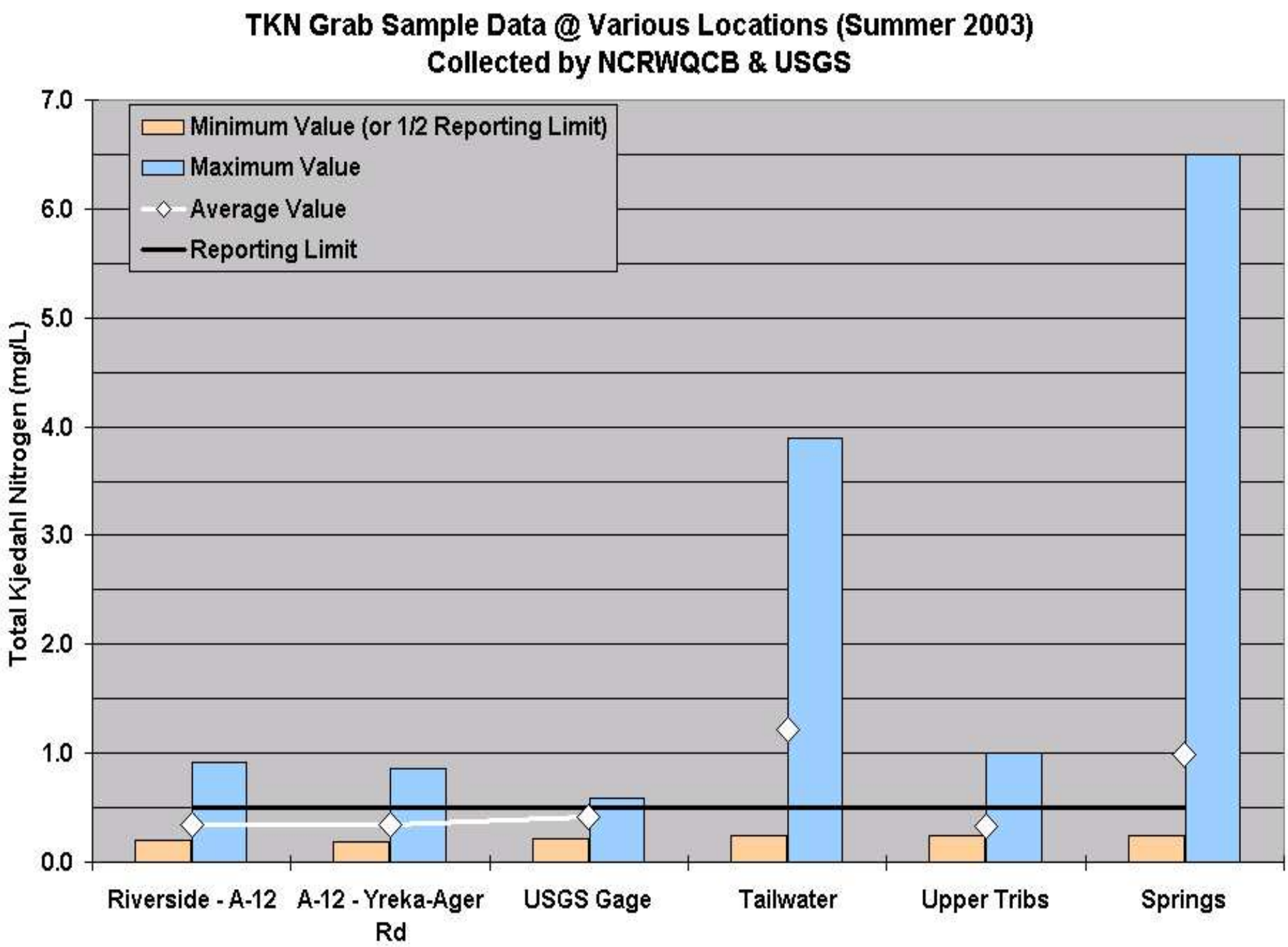
1. Nutrients (nitrogen/phosphorus) enter system via point sources, non-point sources, and in-lake processes,
2. Excess nutrient concentrations and light stimulate growth,
3. Algal growth increases solids and thus reduces light transparency,
4. Aquatic plants consume carbon dioxide and cause pH to rise,
5. Aquatic plants fragment or die releasing ammonia, phosphorus, carbon dioxide, and consume oxygen into water column or sediments,
6. Ammonia undergoes nitrification to yield nitrate. Nitrate is recycled back into system,
7. Ammonia diffuses into atmosphere,
8. Ammonia can become toxic if pH and ammonia concentrations are high enough, and
9. High concentrations of unionized ammonia can cause fish and invertebrate kills and release ammonia into the water column and consume additional dissolved oxygen.

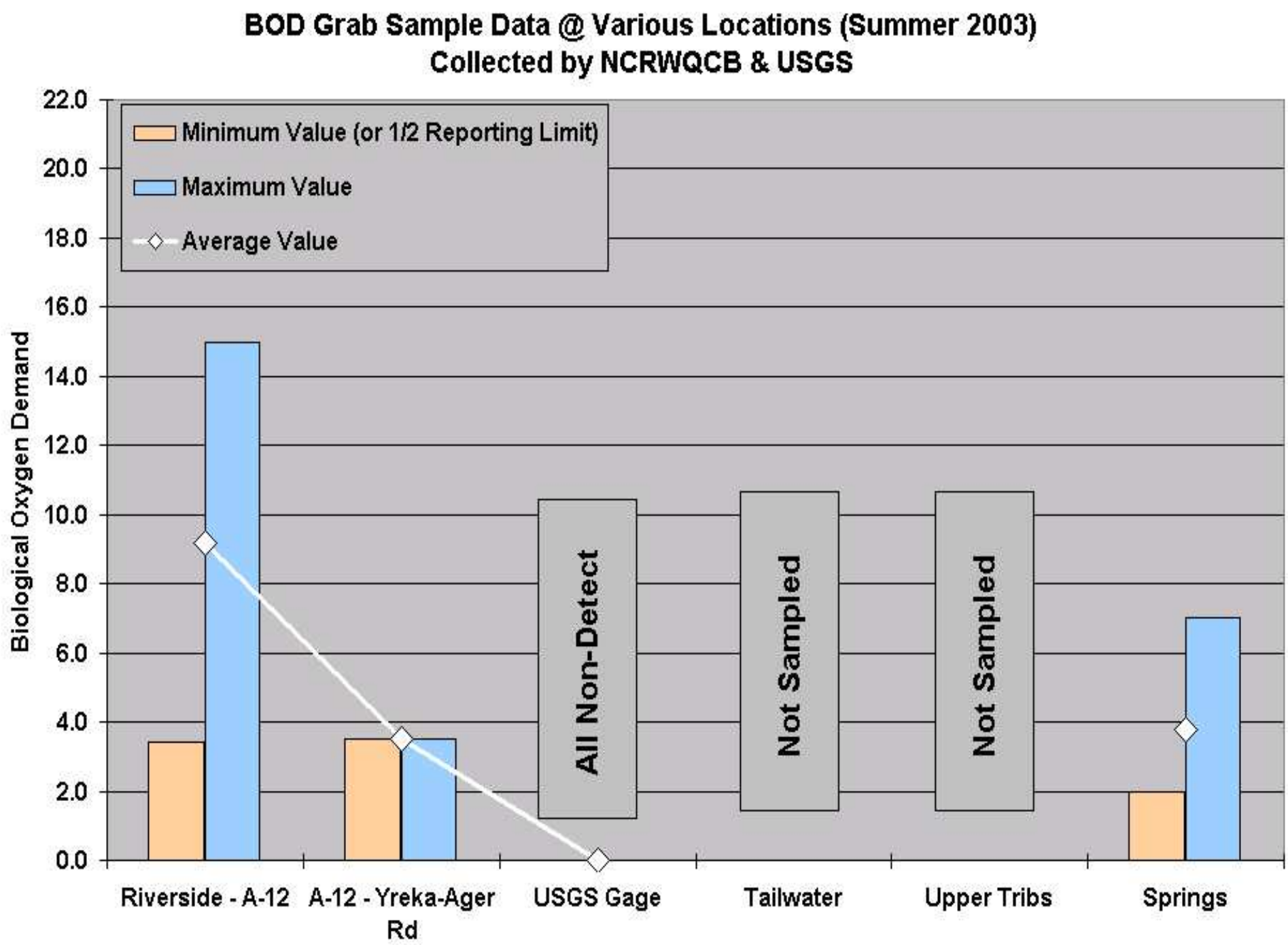

O-PO4 Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Reporting Limit
Ortho-Phosphate (mg/L)
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs

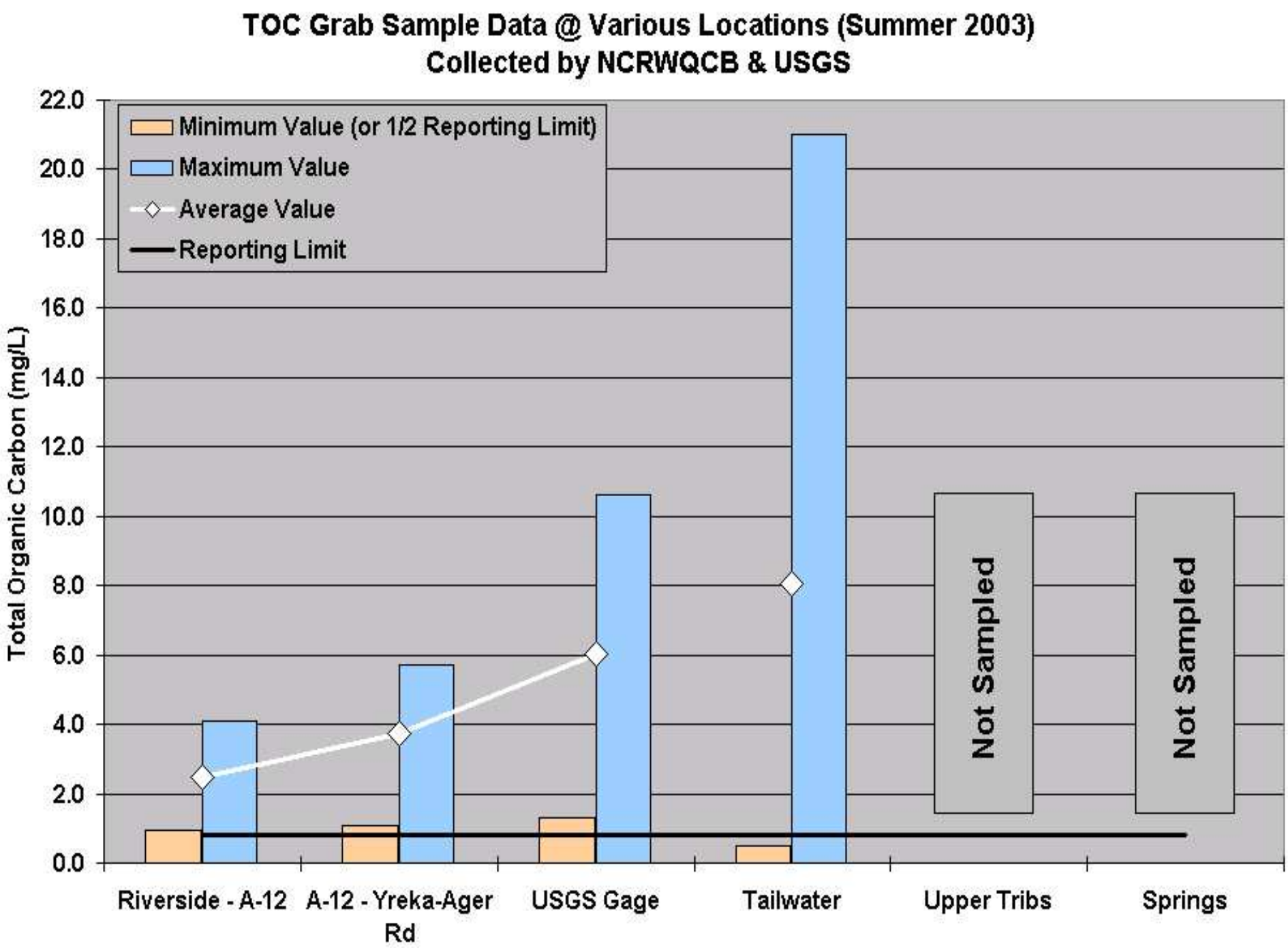

Total Phosphorus Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Reporting Limit
Total Phosphorus (mg/L)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs

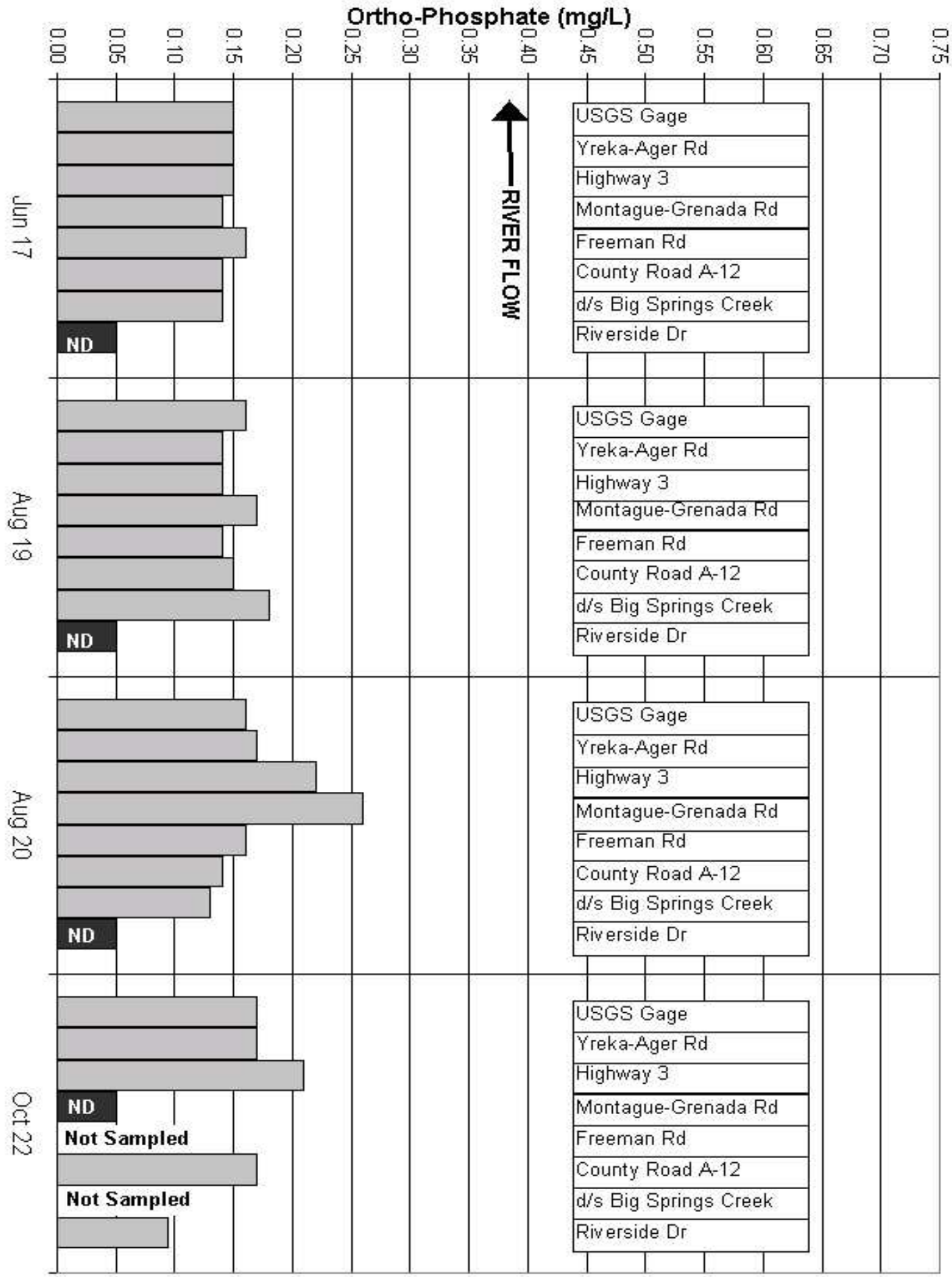

NH3 as N Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Reporting Limit
Ammonia as Nitrogen (mg/L)
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs

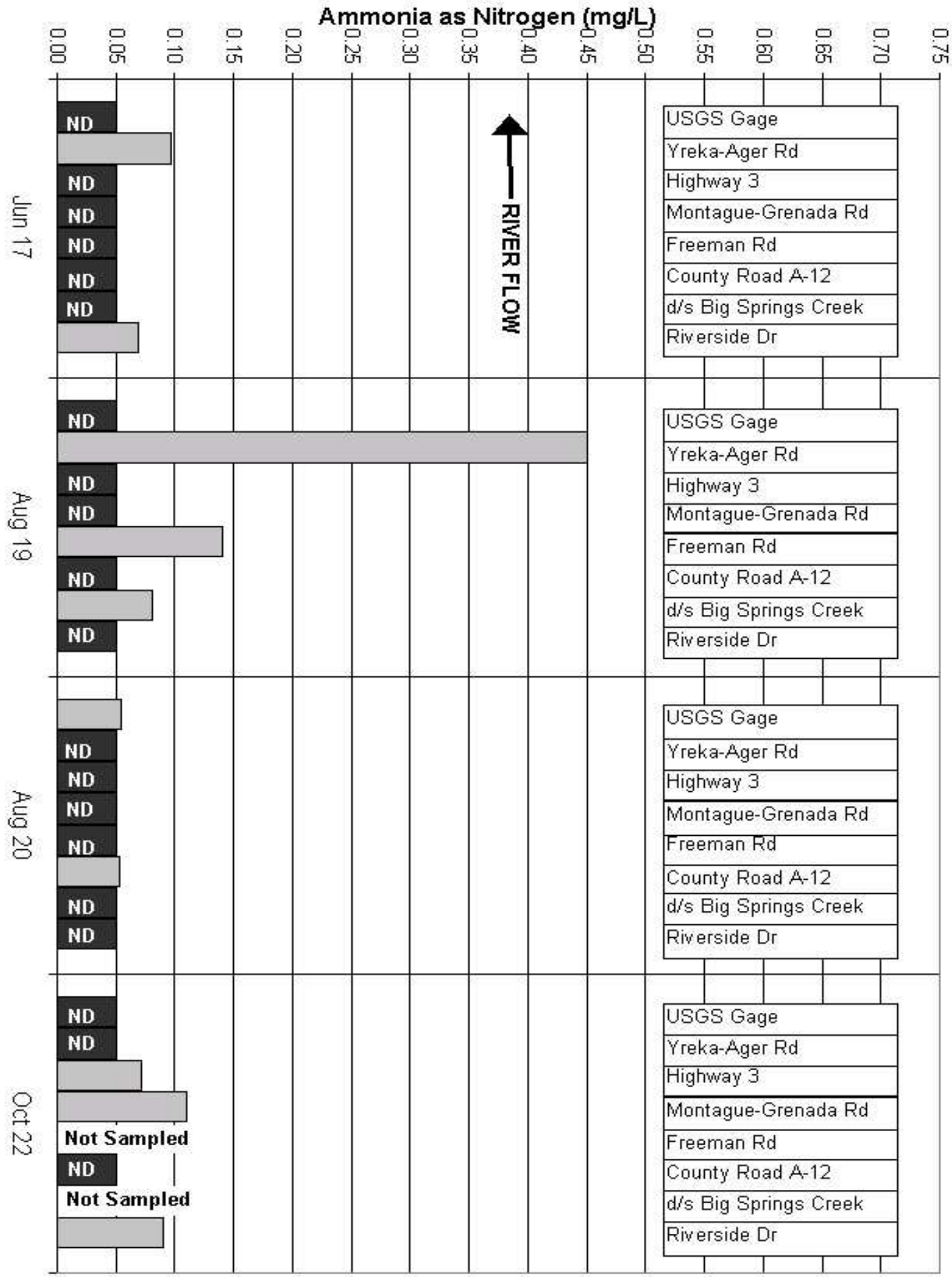

NO2 / NO3 as N Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Reporting Limit
Nitrate / Nitrite as Nitrogen (mg/L)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs

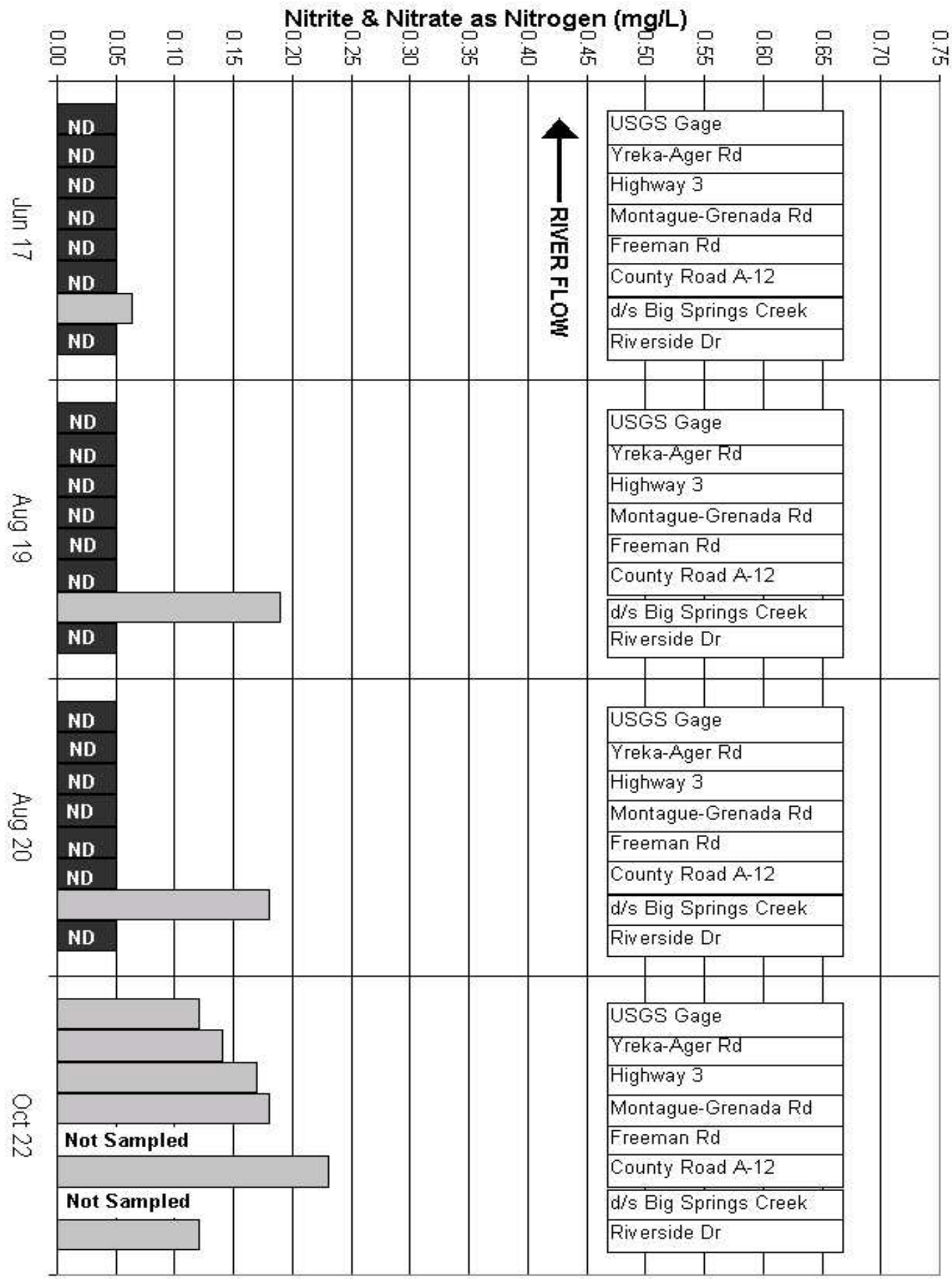

TKN Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Reporting Limit
Total Kjedahl Nitrogen (mg/L)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs


BOD Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Biological Oxygen Demand
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
All Non-Detect
Not Sampled
Not Sampled
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs


TOC Grab Sample Data @ Various Locations (Summer 2003)
Collected by NCRWQCB & USGS
Minimum Value (or 1/2 Reporting Limit)
Maximum Value
Average Value
Reporting Limit
Total Organic Carbon (mg/L)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Not Sampled
Not Sampled
Riverside - A-12
A-12 - Yreka-Ager Rd
USGS Gage
Tailwater
Upper Tribs
Springs


Ortho-Phosphate (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
RIVER FLOW
USGS Gage
Yreka-Ager Rd
Highway 3
Montague-Grenada Rd
Freeman Rd
County Road A-12
d/s Big Springs Creek
Riverside Dr
Jun 17
ND
Aug 19
ND
Aug 20
ND
Oct 22
ND
Not Sampled
Not Sampled


Ammonia as Nitrogen (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
RIVER FLOW
Jun 17
Aug 19
Aug 20
Oct 22
ND
Not Sampled
USGS Gage
Yreka-Ager Rd
Highway 3
Montague-Grenada Rd
Freeman Rd
County Road A-12
d/s Big Springs Creek
Riverside Dr


Nitrite & Nitrate as Nitrogen (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
RIVER FLOW
USGS Gage
Yreka-Ager Rd
Highway 3
Montague-Grenada Rd
Freeman Rd
County Road A-12
d/s Big Springs Creek
Riverside Dr
Jun 17
ND
ND
ND
ND
ND
ND
ND
Aug 19
ND
ND
ND
ND
ND
ND
ND
Aug 20
ND
ND
ND
ND
ND
ND
ND
Oct 22
Not Sampled
Not Sampled

Sediment Oxygen Demand Study

August 12-14, 2003

Shasta River downstream of Highway 3

Table 11. Measured Sediment Oxygen Demand Rates and Sediment Characteristics at Shasta River Sites.

Sites[1]	Date	Replicate	Water Depth (meters)	Blank-Corrected SOD Rate at 20°C (SOD_{20}, $g/m^2/d$) [2]	Sediment Organic Content (%)	Sediment: Percent Finer than 63 microns (%)
Shasta River upstream of Montague-Grenada Road	Aug 12, 2003	1	0.9	2.0	2.3	5.7
		2	0.8	--	1.4	3.2
		3	0.7	1.0	1.7	3.3
Shasta River downstream of Montague-Grenada Road	Aug 12, 2003	1	0.7	1.6	4.8	5.0
		2	0.6	0.5	7.5	54.3
		3	0.5	1.0	4.1	2.4
Shasta River near Highway 3 – site A	Aug 13, 2003	1	0.9	1.5	2.6	2.1
		2	0.9	0.7	1.0	0.8
		3	0.8	0.1	1.5	1.6
Shasta River near Highway 3 – site B	Aug 13, 2003	1	0.9	1.3	1.4	3.3
		2	0.9	1.4	1.2	1.3
		3	0.8	1.7	1.5	2.9
Shasta River near Highway 3 – site C	Aug 14, 2003	1	0.7	2.1	0.9	0.7
		2	0.5	--	1.2	8.9
		3	0.4	2.3	0.8	2.3
Shasta River near Highway 3 – site D	Aug 14, 2003	1	0.6	1.8	6.5	29.9
		2	0.7	--	3.4	48.9
		3	0.7	2.3	6.3	44.4

Table 5. Wastewater Treatment Plant Bracketing -- Water Quality Results from Field Measurement and Grab Sample Analysis, 2003

			Field Parameters					Lab Analysis (mg/L)												
Location		Time	Tw	pH	DO mg/l	DO Sat (%)	Sp Cond	NH3 as N	NO3 as N	NO2 as N	NO2+NO3 as N	Ortho P	Phosphorus	TDS	TSS	TKN	BOD	Chl - a	Pheo-a	TOC
Weed Waste Water Treatment Facility - 6/18/2003																				
	Above	16:20	13.56	8.32	9.70	93.3	167	ND			0.460	0.082	0.160	150	ND	ND				ND
	Below	15:15	14.68	8.27	10.33	101.3	172	ND			0.360	0.100	0.076	150	ND	ND				ND
Weed Waste Water Treatment Facility - 7/22/2003																				
	Above	13:35	15.45	8.04	9.79	98.1	174	ND			0.530	0.094	0.120	150	ND	ND	9.2			ND
	Below	13:00	16.96	8.02	9.67	100.1	177	ND			0.530	0.110	0.100	180	ND	ND	ND			ND
Weed Waste Water Treatment Facility - 10/21/2003																				
	Above	13:40	11.54	7.96	10.04	92.3	168	ND			0.560	0.120	0.098	140	12	ND	ND			ND
	Below	12:50	11.87	7.98	10.20	94.5	173	ND			0.520	0.100	0.074	140	10	ND	ND			ND
Montague Waste Water Treament Facility - 6/18/2003																				
	Above (1)	13:00	21.47	8.22	12.39	141.4	541	0.220			0.140	0.220	0.270	340	18	0.78				1.8
	Below (1)	13:35	23.14	8.31	10.56	123.4	574	0.052			0.090	0.250	14.000	380	19	1.30				2.2
	Below (2)	11:49	22.23	7.85	11.65	134.3	692	0.260			0.210	0.250	0.260	430	ND	0.90				0.9
Montague Waste Water Treament Facility - 7/21/2003																				
	Above (2)	12:25	24.39	8.37	11.26	134.9	624	0.071			0.270	0.240	0.400	420	16	0.82	2.7			7.9
	Below (1)	12:10	23.27	8.34	13.68	161.2	590	0.071			0.130	0.220	0.220	400	14	0.97	ND			8.0
Montague Waste Water Treament Facility - 10/22/2003																				
	Above (2)	9:30	11.53	8.05	8.63	79.4	806	0.094			0.390	0.092	0.580	500	ND	ND	ND			3.0
	Below (1)	9:50	11.53	8.19	12.20	93.8	805	0.097			0.340	0.260	0.051	500	ND	ND	ND			2.9
Yreka Waste Water Treatment Facility - 6/19/2003																				
	Above (2)	11:20	16.07	8.01	10.91	110.9	502	ND			0.170		ND			ND				
	Above (1)	8:20	14.06	7.83	8.33	81.3	497	ND			0.620	ND	ND	270	ND	ND				0.2
	At	10:00	14.23	7.88	9.69	94.8	506	0.094			0.720	0.070	0.070	280	ND	ND				0.2
	Below	10:30	14.68	8.26	10.98	108.4	509	ND			0.870	0.150	0.150	280	ND	0.56				0.3
Yreka Waste Water Treatment Facility - 7/21/2003																				
	Above (2)	14:30	19.61	7.59	10.03	109.8	557			ND	0.098	ND	ND			ND				
	Above (1)	13:10	18.50	7.71	10.22	109.1	520	ND			0.860	ND	0.057	330	ND	ND	ND			ND
	At	15:10	19.25	7.80	9.43	102.7	535	0.200			1.000	0.150	0.130	340	ND	ND	ND			ND
	Below	15:40	22.70	8.26	8.67	100.9	542	0.180			1.600	0.170	0.210	360	10	ND	ND			1.2
				Reporting Limits (mg/L)				0.050	0.050	0.050	0.050	0.050	0.050	10	10	0.50		0.0005	0.0005	0.80

Location Notes:

Weed Wastewater Treatment Facility "Above" = Boles Creek approx. 200 meters downstream of bridge to the Weed Golf Club.
Weed Wastewater Treatment Facility "Below" = Boles Creek approx. 200 meters downstream "Above" location.
Montague Wastewater Treatment Facility "Above 1" = Oregon Slough at Ager Road.
Montague Wastewater Treatment Facility "Above 2" = Oregon Slough approximately 0.7 miles downstream of Ager Road.
Montague Wastewater Treatment Facility "Below 1" = Oregon Slough at Southern Pacific Railroad tressel.
Montague Wastewater Treatment Facility "Below 2" = Oregon Slough approximately 0.5 miles downstream of Southern Pacific Railroad tressel.
Yreka Wastewater Treatment Facility "Above 2" = Yreka Creek at Oberlin Road.
Yreka Wastewater Treatment Facility "Above 1" = Yreka Creek at Highway 3.
Yreka Wastewater Treatment Facility "At" = Yreka Creek at Cutoff Trench.
Yreka Wastewater Treatment Facility "Below" = Yreka Creek at Anderson Grade Road.

Notes:
ND = Non-Detect (parameter is not present or present at concentrations below the laboratory reporting limit).
An empty cell = No sample for this parameter

Table 8. Shasta River Bacteriological Sample Results 2003

Site	Total Coliform (MPN/100 ml)	Fecal Coliform (MPN/100 ml)	E. coli (MPN/100 ml)	Enterococcus (MPN/100 ml)
Montague-Grenada Road	≥ 2,419.2	300	249.5	1091.0
Highway 3	≥ 2,419.2	500	285.1	165.2
CA DHS Threshold Level	10,000	400	235	61

Notes:

MPN = Most Probable Number

The California Department of Health Services (DHS) recommends posting fresh water beaches when single sample values exceed the levels identified in the fourth row of the table. California Department of Health Services. July 24, 2001. Draft Guidance for Fresh Water Beaches.

http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm

Total and fecal coliform, enterococcus, and e. coli are "indicator organisms" of microbiological contamination and are used by health authorities as surrogates for disease-causing organisms that are likely to be present in sewage, but are difficult to analyze for directly. Presence of these indicator organisms at both Shasta River sample locations at levels above the DHS thresholds indicates there may be disease-causing organisms present in the Shasta River.

Purpose of Meeting

- **To update the TAG on the status of Shasta River TMDL development activities.**
- **To summarize 2002 & 2003 water quality monitoring activities and results.**
- **To discuss data analysis approach.**
- **To discuss 2004 water quality monitoring plans.**
- **To answer questions and receive feedback.**

Data Analysis Tasks and TMDL Development Schedule

- Data compilation and summaries (Complete)
- Development of conceptual model framework (Complete)
- Statistical analysis of data (Spring-Summer 2004)
- Draft Problem Statement (June 2004)
- Development of water quality model (Winter - Summer 2004)
- Model calibration (June - July 2004)
- Water quality monitoring and assessment (July – October 2004)
- Model scenario runs and allocation of loads (August – September 2004)
- Draft TMDL report (December 2004)

Water Quality Database

- All available water quality data (1952 to present) has been compiled – grouped by monitoring location
- Summary statistics of data

Conceptual Model Framework – Temperature

- Water temperatures vary spatially and temporally
- Factors affecting temperature:
  - Meteorologic conditions
  - Flows
  - Shading
  - Channel substrate and riparian soil conditions
  - Surface and subsurface water interactions

Conceptual Model Framework – Dissolved Oxygen

- Dissolved oxygen concentrations vary spatially and temporally & are strongly correlated with temperature.
- Important features, processes, and events affecting DO concentrations:
  - DO concentrations vary with stream flow.
  - DO concentrations exhibit wide diurnal fluctuations driven by photosynthesis and respiration of aquatic plants.
  - Aquatic plant growth is controlled by (1) availability of nutrients in the water column and substrate, (2) light availability, and (3) channel substrate conditions.
  - Sediment oxygen demand varies spatially and exerts a steady consumption of DO.
  - Biological oxygen demand varies spatially and exerts minimal consumption of DO.

Important features, processes, and events affecting DO concentrations, continued:

- DO concentrations in Lake Shastina vary with depth, reaching near-zero at the lake bottom during summer
- Lake Shastina changes the form and concentrations of nutrients and constituents that exert an oxygen demand.
- Impoundments have a localized effect on DO concentrations.

Water Quality Model Development

- Contract with Watercourse Engineering, Inc. (WEI) and UC Davis
- Modifying Tennessee Valley Authority (TVA) River Modeling System (RMS) model of Shasta River water temperature (RQUAL) and flow (ADYN) developed by WEI for Shasta Valley RCD.
  - Updating to RMS Version 4.0 – improvements to riparian vegetation & shading logic
  - Extending RQUAL to include dissolved oxygen
  - Geographic extent: Shasta River mouth to Dwinnell Dam

Water Quality Model Development, cont.

- In RQUAL DO concentrations are controlled by photosynthesis and respiration of aquatic plants, SOD, BOD, and NBOD.
- The model does not “grow” plants, but exhibits DO production (photosynthesis) and consumption (respiration) given a set standing crop.
- Model will be run for 2-week periods May through September.
- A separate “box model” will be run to evaluate aquatic plant response to nutrients. This nutrient/ aquatic plant response model can “grow” plants given input parameters of growth rate, respiration rate, mortality, nutrient concentration, light availability, and substrate conditions

Water Quality Model Development, cont.

- The temperature component of the RMA model has been calibrated to 2002 data.
- Dissolved oxygen component will be calibrated to 2002 & 2003 data.
- Analytical approach for Lake Shastina is still being evaluated.

2004 Water Quality Monitoring

- Model calibration exercise will help identify data gaps.
- 2004 monitoring plans:
  - Riparian vegetation surveys
  - Aquatic plant surveys
  - Channel substrate conditions surveys
  - Shasta River nutrient grab samples
  - Irrigation return flow grab samples
  - Irrigation return flow temperature monitoring

Next TAG Meeting

- August to review preliminary model results and discuss model scenario runs.

Contact Us

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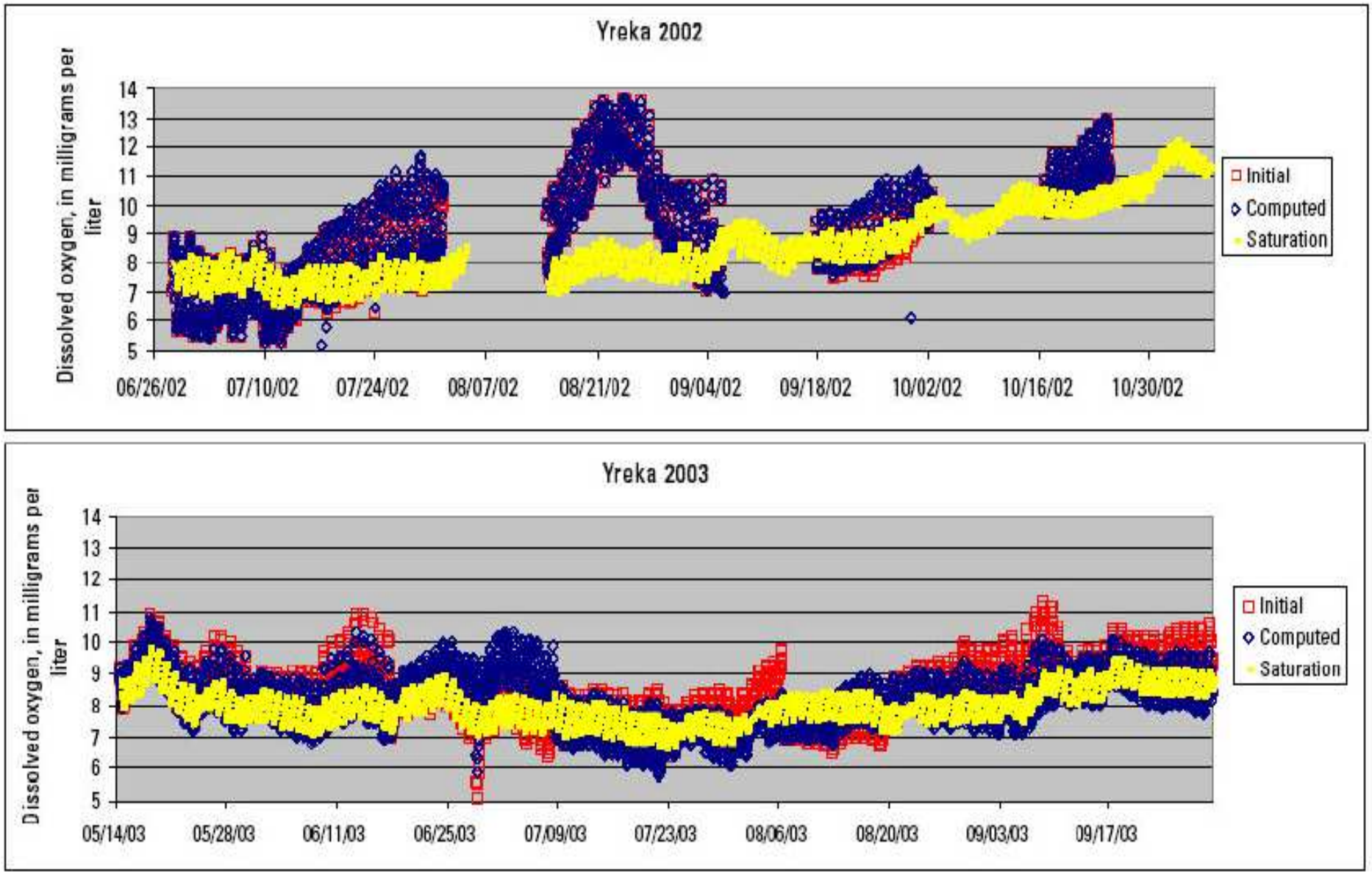
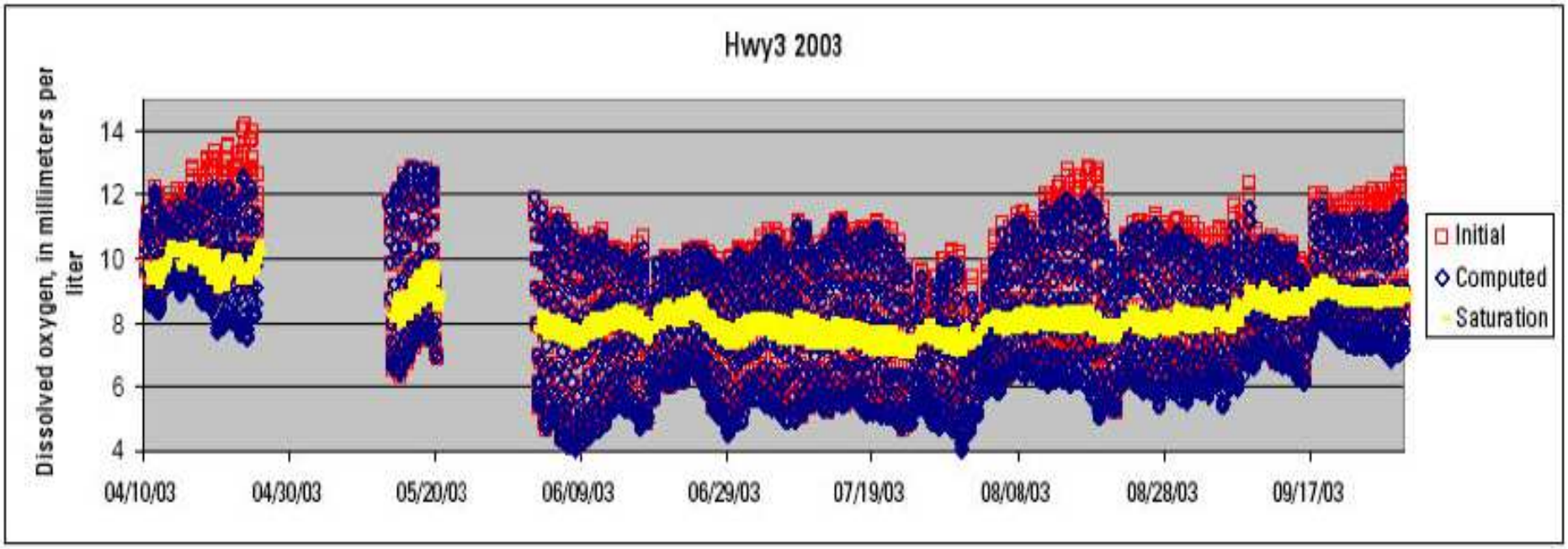
For Further Information, and to Download TMDL Documents:

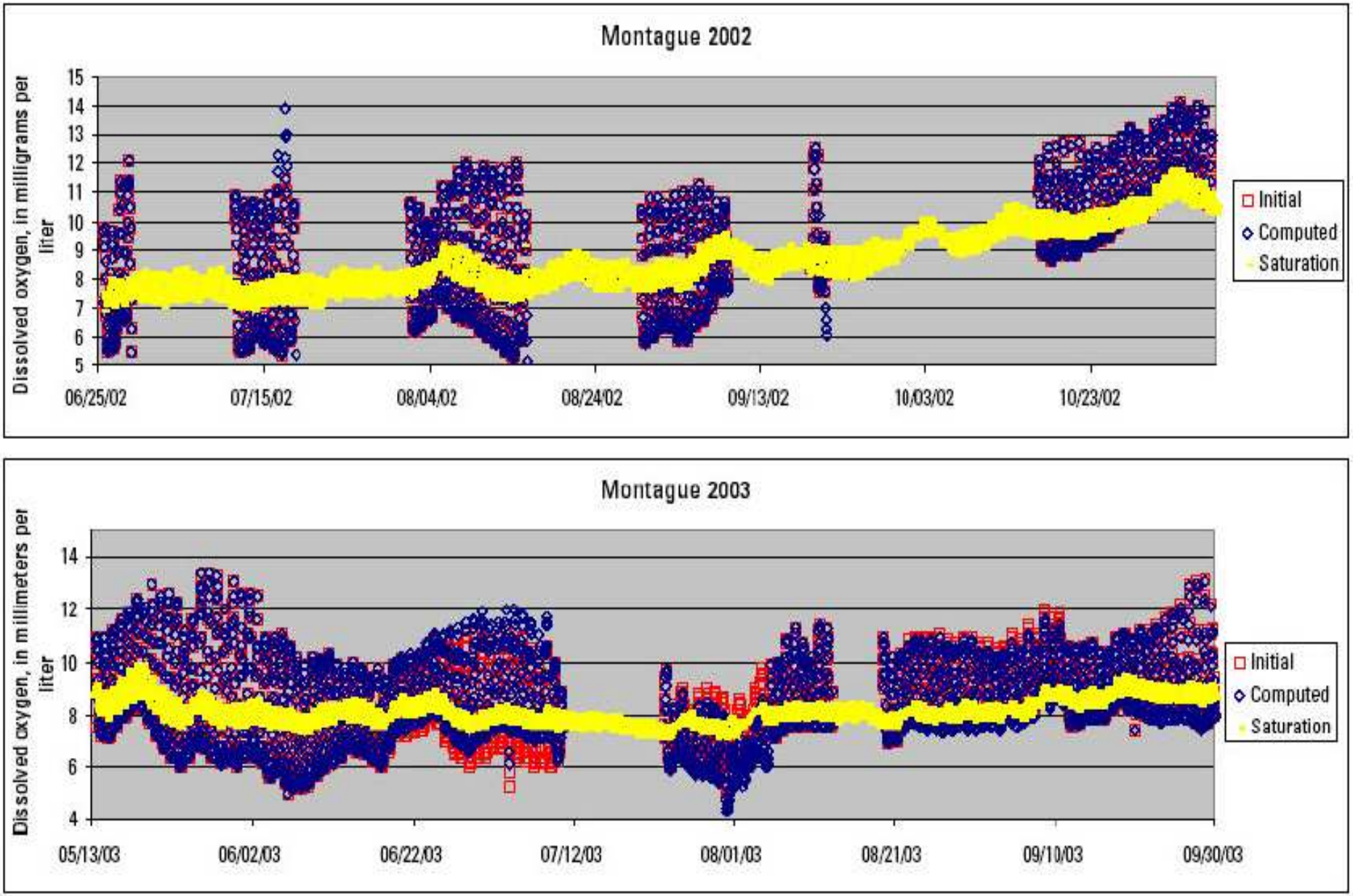
http://www.swrcb.ca.gov/~rwqcb1/programs/tmdl/shasta/shasta.html



Measured continuous data of dissolved oxygen with initial edited record, computed record, and saturated values for 2002 and 2003 for the USGS site on the Shasta River at Yreka. The Regional Water Board refers to this station as "Shasta River Near Mouth at USGS Gage".



Measured continuous data of dissolved oxygen with initial edited record, computed record, and saturated values for 2003 for the USGS site on the Shasta River at Hwy 3. The Regional Water Board refers to this station as "Shasta River at Highway 3".



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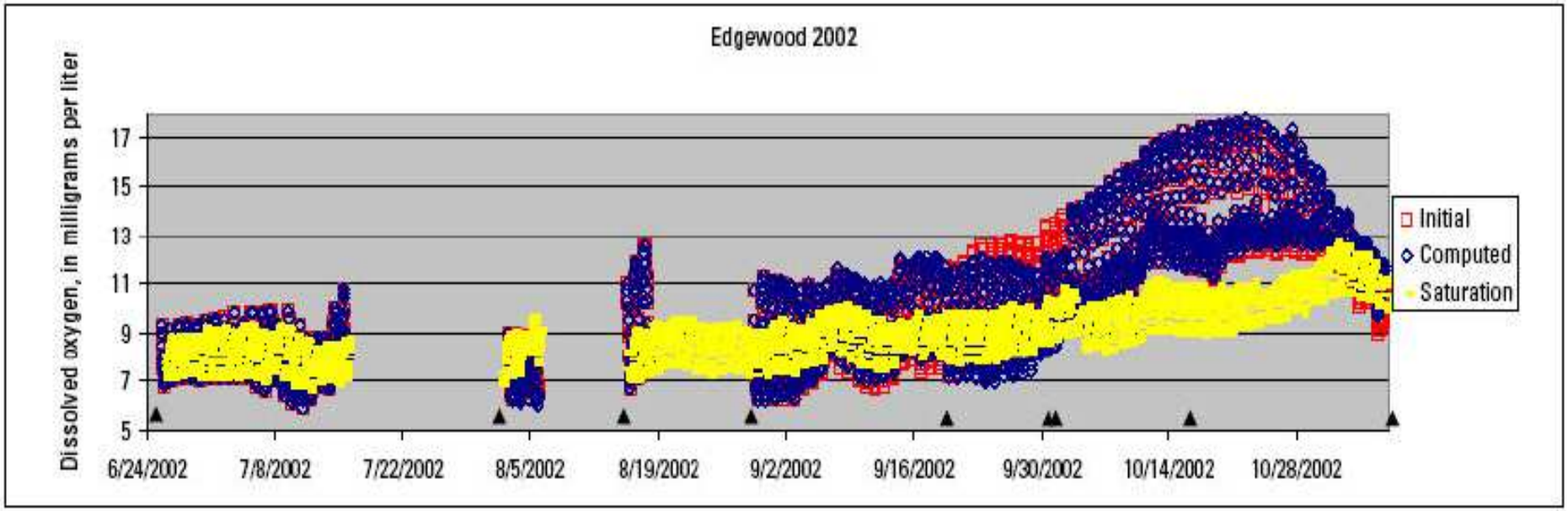

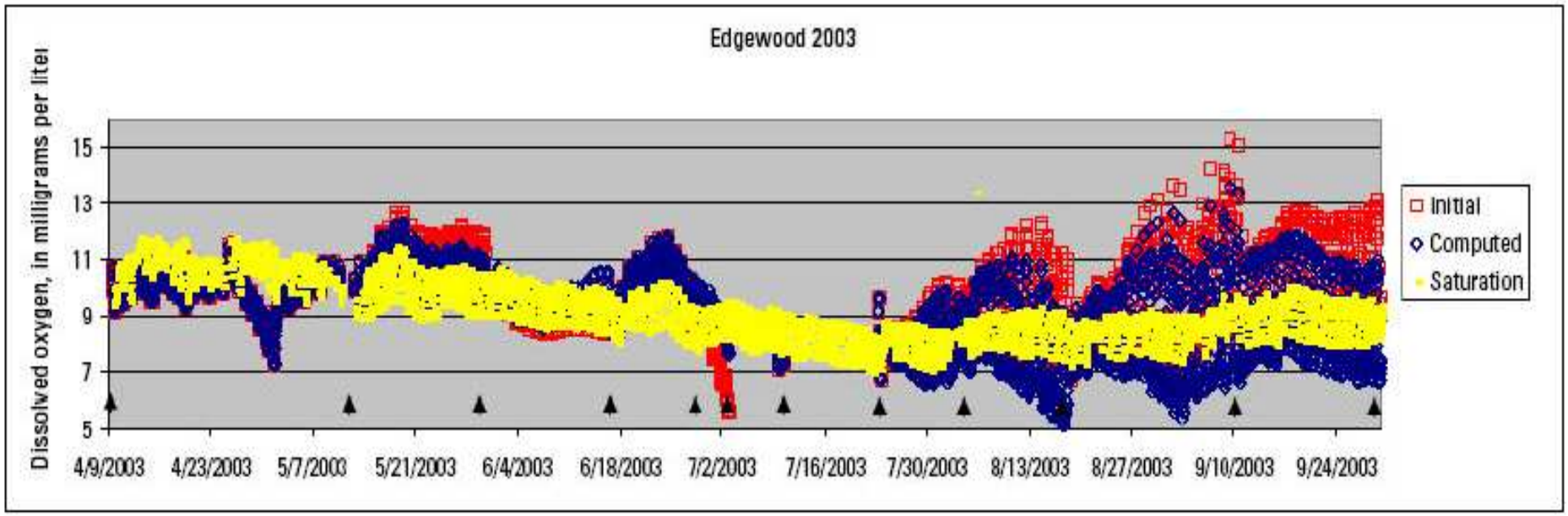

Measured continuous data of dissolved oxygen with initial edited record, computed record, and saturated values for 2002 and 2003 for the USGS site on the Shasta River at Edgewood. The Regional Water Board refers to this station as "Shasta River at Edgewood Road". Filled triangles identify dates of site inspections by USGS